Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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8-22

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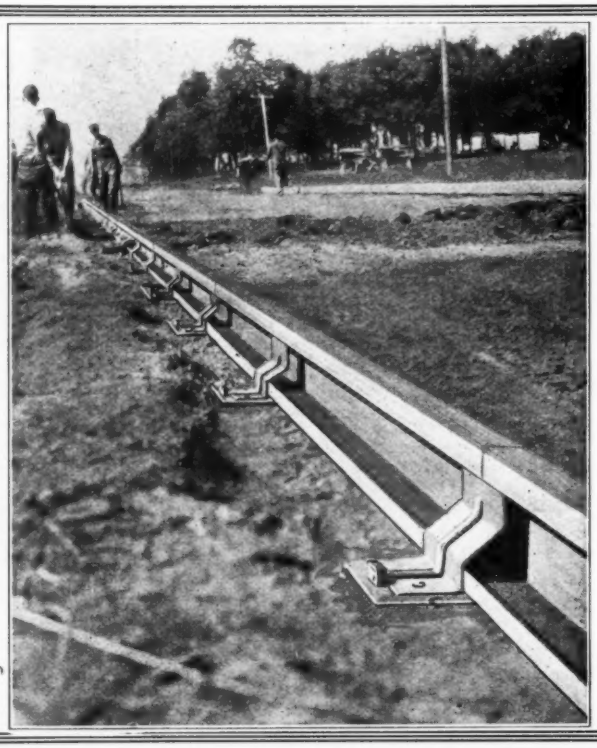

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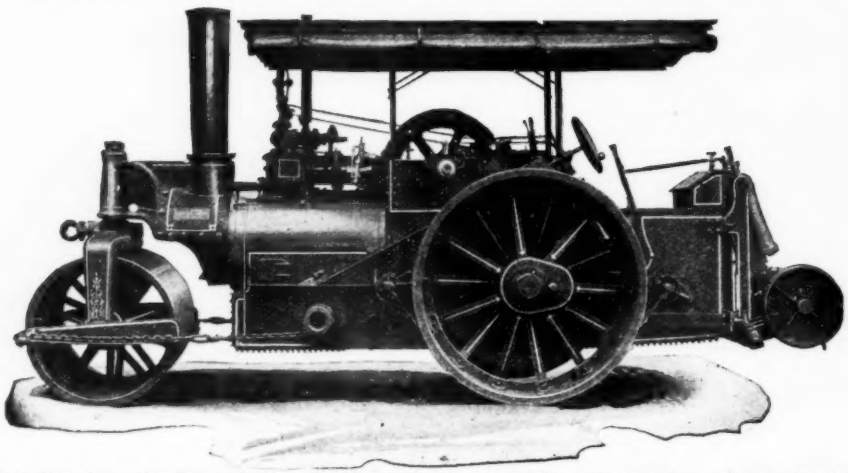

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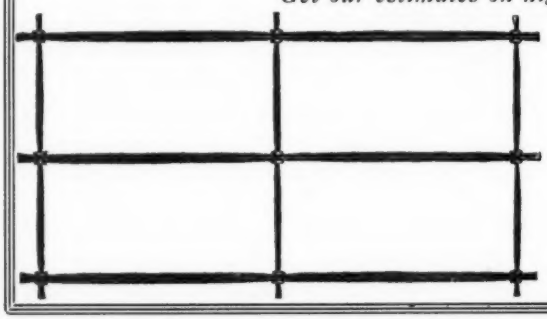

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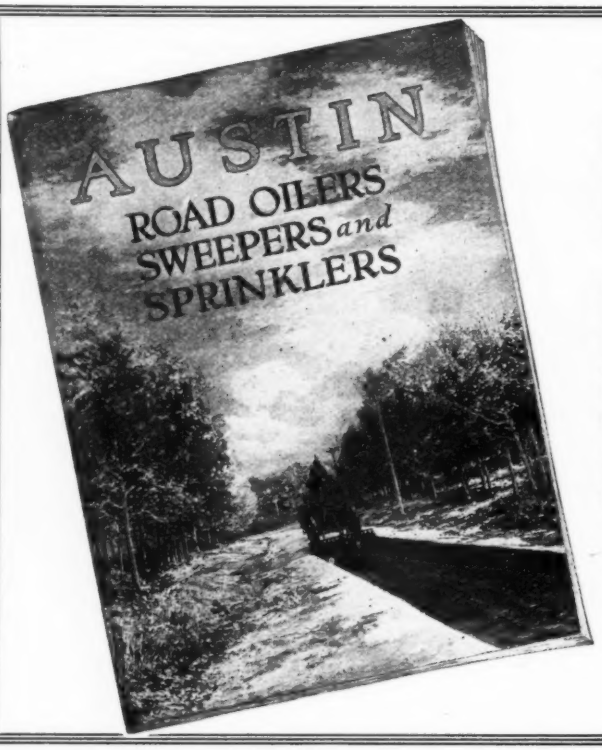

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of great interest and real value to all those interested in the most efficient and economical methods of dust laying and road maintenance.

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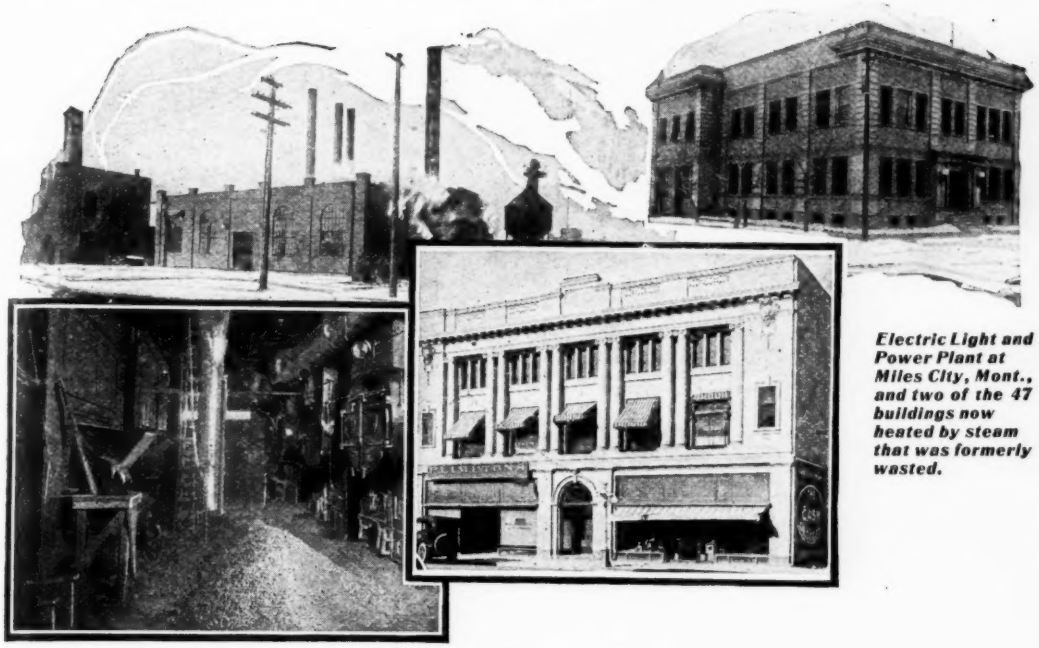

Electric Light and Power Plant at Miles City, Mont., and two of the 47 buildings now heated by steam that was formerly wasted.

Waste Steam Used for Community Heating

After facts brought out in court showed that Miles City, Montana, was losing more than $100 a day by not selling exhaust steam, permission was given the electric station to proceed with a plan for distributing this waste steam to heat nearby buildings.

A bulletin has been prepared showing the development of this profitable municipal venture. Today, some 47 buildings are heated from the central station plant. Heat sales run over $32,000 a year. Fire hazards are reduced because individual heating plants are thrown out of these buildings. Dirt and dust of coal and ash handling are eliminated. This is one of the four hundred installations of Community Heating designed and installed by our engineers.

If there is an electric light plant or factory in **your** city wasting steam, why not use it to heat nearby buildings? Buy your steam heat as you buy gas or electricity—by meter!

Write for Bulletin No. 20-M E covering Adsco Community Heating of a group of buildings from Central Station Steam Plant. Bulletin No. 158-M E covers Adsco Heating for individual buildings. Architects, engineers and heating dealers should also ask for Bulletin No. 159-M E.

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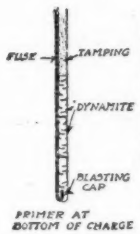
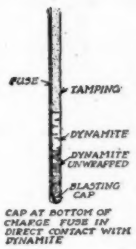
Dynamite Efficiency Depends upon Proper Priming

Load Dynamite the *Wrong* Way and You *Lose* Money



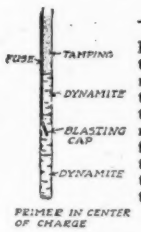
Here is one WRONG way:

For instance, the cap with fuse should not be placed at the bottom of the hole like this as the side spit of the fuse would be likely to set fire to the dynamite.



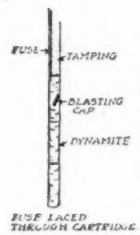
—here is another

This is also bad practice as the cap is pointed *away* from the charge instead of toward it and the fuse is also likely to set fire to the dynamite before the cap explodes.



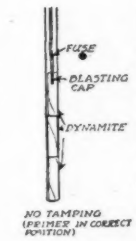
—and another

Even the middle of the charge is not the right place to put the primer as the top cartridge does not receive the full force of the cap and the fuse may ignite the powder that touches it.



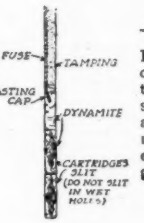
—still another

Lacing the fuse through the priming cartridge is bad practice. It nearly always lets the fuse side spit into the dynamite.



Another WRONG way:

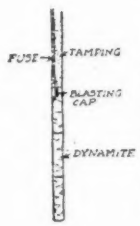
This kind of loading, without tamping, is expensive and inefficient as the top cartridge wastes most of its force blowing out the hole. The Bureau of Mines reports that tamping increases the effectiveness of high explosives enormously



—and another

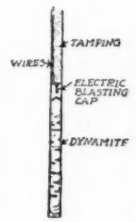
If the holes are full of water the cartridges of dynamite should not be slit as water affects nearly every kind of dynamite except gelatin.

Load Dynamite the *Right* Way and You *Save* Money



The RIGHT way:

This way, with the cap in the top of the *top* cartridge, pointing *down* toward the bulk of the charge, with lots of tamping and no part of the fuse touching the powder will give you a perfect shot every time.



Another RIGHT way:

Or even if you fire electrically, you will get best results this way as the electric blasting cap is placed so as to exert its *maximum* detonating effect on *all* the explosive in the charge.

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Explosives Department
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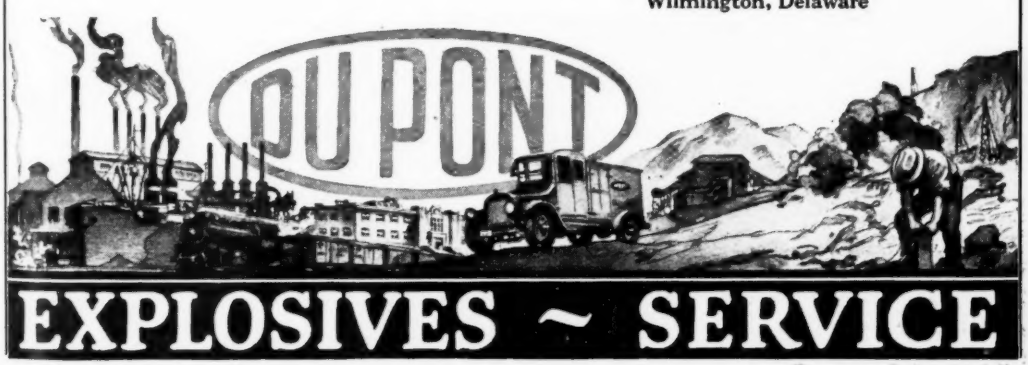

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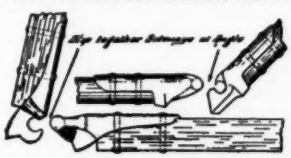

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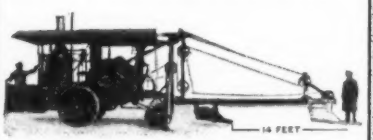

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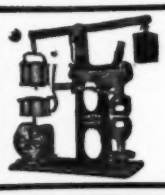

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EDITORIAL

RECIPROCAL HIGHWAY COURTESY

The courtesy campaign being conducted by the American Automobile Association in connection with the Chicago Automobile Trade Association and the National Automobile Dealers' Association, in cooperation with local motor clubs, is deserving of universal commendation and support. It is expected that motor vehicles throughout the entire country will soon be displaying green and white stickers on windshields bearing the words "Automobile Courtesy," in large letters, over the name of the local motor club. The reciprocal practice of highway courtesy will greatly increase the safety as well as the pleasure of highway travel.

Commenting on the courtesy campaign and its objects, D. H. Lewis, of the American Automobile Association, recently said: "We believe that 50 per cent of the automobile accidents which happen on the highways of the United States could be avoided through the use of a little automobile courtesy. Courtesy costs nothing and brings greater results than any other element entering into the driving of an automobile. Real automobile courtesy demands that we give the other fellow his share of the road; that we dim our lights when meeting another car at night; that we recognize the fact that the man behind us blowing for the road wants to get by and is not challenging us to a race; in short, it means being agreeable in all these little things that go so far toward avoiding friction."

This campaign, to be of greatest use, must include all users of the highway, including cyclists and pedestrians. Often pedestrians swarm and sprawl all over the road, with their backs to traffic, and pay no attention to horn signals to move over, except to say, as the motorist finally gets by: "Aw, go to hell!" or, "You've got a horn, have you?" Such discourtesy is now common, and it is nothing short of miraculous that more pedestrians are not being run down every day. Bicyclists are almost as bad as pedestrians, wabbling all over the road in utter contempt of the rights of other highway users.

There is need for reforms in the practices to which Mr. Lewis calls attention, especially in pulling over to let the man behind get by when he signals his desire to do so. Many motorists seem to regard this as a reflection on their car, if not a personal insult, and either start to race or refuse to give way by so much as an inch. This offense is particularly common in the parts of the country peopled almost exclusively by a very pure strain of old American stock, where the people are drunk on freedom and where every man considers himself an uncrowned king. It is our opinion that an occasional "crowning," say with a pick handle, would greatly improve this class of royalty. But as that isn't being done, now, a courtesy campaign seems the shortest road to reformation.

THE BEST MUNICIPAL ADVERTISEMENT

A well-paved system of streets is the best advertisement the average city can hope to have. Under modern conditions visitors come to a city largely by motor, and their eyes, of necessity, are directed primarily to the pavement. If the pavement looks good and rides well the visiting motorist forms an excellent opinion of the city, but if it looks and rides rough he gets out of town as soon as he can and hopes that he may never have to return.

Sometimes civic bodies spend much money to persuade people to locate in a city. Not long ago a case was noted where such a body, while trying to attract new industries and new citizens, urged a city council to cut its street maintenance budget. Fortunately, the city council appreciated the incongruity of these efforts and the budget was not reduced.

MUNICIPAL

It may be worth while to call attention to the fact that a very considerable number of people mispronounce the word municipal. We do not refer merely to the so-called proletariat, down on the street, but to that presumably higher class that spends its working time in offices. If engineers are excepted, not over half the people the editor meets in business pronounce municipal correctly. Some of the more common variants may be of interest.

Perhaps the most frequently encountered mispronunciation arises from a faulty division into syllables: thus we hear mu'-ni-cipal instead of mu-nic'-i-pal. It will be seen that more than faulty accenting is responsible for this atrocity.

Another rather frequent offense in this connection is "monicipal," the "mon" having the same value (phonetically) as in money. But the ultimate is reached in mu'-ni-cip-i-al. Here, in addition to faulty accenting and syllabifying, an extra i is introduced gratuitously, without cause or provocation, without merit or claim. Contemplation of this form so far paralyzes our faculties that it must be left to our readers to determine whether it should be ascribed to illiteracy or to art.

PUBLISHING TRUCK OPERATING COSTS

Too many truck hauling contracts are being taken at prices so low that the contractor is sure to lose money on the job. He is defeated in advance, and the most he can hope to do, after he realizes the predicament he is in, is to limit the amount of his loss.

Without going too much into detail, it may be said that during the business depression truck sales methods have, in many cases, been made too easy for the buyer. It has happened many times that men of small means and experience have come into possession of trucks and have gone out at once to bid on jobs where they knew little of the cost of the work on which they had to fix a price. We have heard of cases where the contract price was not half the actual cost to the contractor.

Of course, there will always be some losses on contract work of any sort, but one of the best methods of limiting such losses is to make actual costs public. We believe the entire truck industry should join with truck owners in making truck hauling costs widely known through publication. This magazine will be glad to publish authentic cost data on motor trucking.

There are arguments against the course here advocated, and we are familiar with them, having had much experience with the publication of construction costs years ago. But at this stage in the development of the truck industry the arguments favoring the publication of trucking costs outweigh those that may fairly be raised against this policy. It is true that the inexperienced will misuse published cost data, but this is regarded as a lesser evil than the present condition, where the inexperienced possessor of a truck oftentimes lacks even a traditional knowledge of trucking costs.

PUBLIC INTEREST IN TEST ROADS

The fact that motor traffic has, to a considerable degree, made obsolete certain types of roads, has been well understood by the public for several years. Latterly a large section of the public learned that highway engineers scarcely knew which way to turn in building roads with available funds to handle present and prospective traffic. The public took a very reasonable, and a very sympathetic, view of the highway engineer's dilemma. He has been exceedingly fortunate in escaping criticism; he should be careful not to disturb the present attitude of the public with reference to road failures and the responsibility for them. Just now failures are attributed to forces which the engineer does not entirely control; he is absolved from blame and left in a very dignified position.

When the test road idea was taken up by engineers the public took a very lively interest in it. Some of the test roads have, perhaps, been advertised rather too well. Newspaper editors, among others, have worked themselves into a position where they seem to expect a complete answer to the road-making riddle from the results of tests now under way. An interesting illustration of this fact was noted recently. A certain widely-read and highly-regarded weekly newspaper printed an editorial on "Practical Road Building" which was written around one of the test road studies now under way. The two most important daily newspapers in the Middle West reprinted that editorial on the same day. Doubtless other papers ran the same matter. Thus the public is held on the very tiptoe of expectancy with reference to results from these experiments.

Since this is the case, and we feel sure it is, those who are responsible for giving out conclusions based on the performance of these test roads should be very sure of any position they take before the public. Conditions are just right now for the public to accept as established fact what may prove to be nothing more than an erroneous opinion. The public will cling to such fallacies long after they have been recognized as such and abandoned by engineers.

While in entire accord with the objects of test roads, we wish again to advise against drawing sweeping conclusions from inconclusive data merely because the tests have cost a lot of money and because the public expects all the uncertainties to be cleared up forthwith.

Constructing Bituminous Concrete Pavement on Crushed Stone Base on Heavy Traffic Providence-Danielson Pike in Rhode Island.

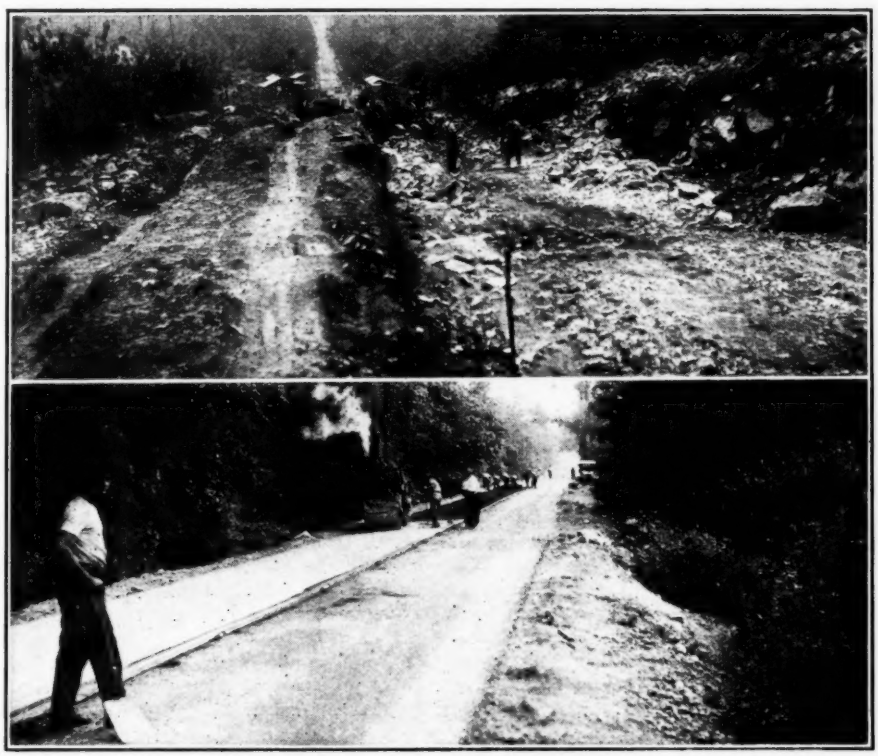
Use of Gravel and Stone Foundations Effective in Insulating Pavement from Serious Effects of Capillarity in Dense, Impermeable Soils.

By Irving W. Patterson, Mem. Am. Soc. C. E., Chief Engineer, State Board of Public Roads, Room 11 State House, Providence, Rhode Island

One of the most interesting state highway projects in Rhode Island is the reconstruction of the road between Providence and Danielson, Connecticut. Originally this route in Rhode Island was built as waterbound macadam, although the State of Connecticut had not hard-surfaced the road between Danielson and the State line. Co-operation by the State Highway Departments of Connecticut and of Rhode Island has resulted in the building of this route entire so that it will serve as the most direct route from Providence to Hartford, and to other cities in central Connecticut.

Six miles of this route in Rhode Island were reconstructed previous to 1920, and the remaining twelve miles were rebuilt during 1921 and 1922. The work during the last two years is interesting especially because of the use made of local materials and because also of the methods adopted in the design of foundations and drainage.

The use of local materials was considered by the State Highway Department to be very desirable in view of the fact that imported materials would have been very expensive because of the long haul from the nearest railroad. Foundations were constructed of gravel and of stone and the pavement consists of a bituminous



VIEWS ON CONSTRUCTION OF DANIELSON PIKE IN RHODE ISLAND.
Views Show Typical Excavation and the Laying of Bituminous Concrete Pavement.

concrete surface laid upon a crushed stone base. The only material used in large quantity which was not obtained upon the site is the asphalt binder, which was hauled in bulk from asphalt refineries located in Providence.

Unfavorable Subsoil Conditions

The sub-soil conditions for the greater part of the twelve miles rebuilt during the last two years are particularly unfavorable. The waterbound macadam surface of the old road each spring broke up badly under frost action, and parts of the road each spring were impassable except for very light vehicles. Ledges and large boulders are very numerous throughout the section traversed by this road, and submerged bars of ledge were responsible in no small part for the serious effects of frost action. For three miles adjacent to the State line is a high plateau, in general fairly level, so that the run-off is rather poor, and upon which the prevailing subsoil is a yellow, loamy, clay, extremely unstable during thaws in the spring and winter. The macadam road built upon this plateau failed badly under frost action during the first spring after its construction.

Intensive Study of Subsoils

The intensive study of sub-soils was an interesting feature of the design of this road. The land in general is very springy, and springs flowing during a large part of the year in the road gutters were numerous upon the longer hills. The water was intercepted by ditches or by drains, so that the permeable foundations provided are not called upon to carry an appreciable amount of water. Since the subsoil is of very high capillarity, it was considered necessary in addition to ditches and drains to protect the pavement by a layer of very permeable material directly beneath. Stone fill was provided through ledge in all cases because of the necessity for taking care of considerable seepage of water through the seams. Gravel foundations predominated and were used in all cases where the existing material in the sub-grade was particularly unstable. In some cases stone fill was laid upon light gravel foundations so that soft material would not work up through the stone fill and detract ultimately from its effectiveness.

Over the high plateau referred to where the sub-soil conditions are particularly unfavorable and where the land in general is swampy, the grade of the road was raised uniformly 20 ins. above the grade of the old road and the filling was done with coarse, stony gravel of very low capillarity. There was practically no excavation upon this section of the road.

VIEW OF FINISHED BITUMINOUS CONCRETE PAVEMENT ON DANIELSON PIKE IN RHODE ISLAND.

The Local Materials

The quality of the local rock in this section of the State is rather too poor to permit its use with success in a pavement surface. The rock was screened to large sizes for the base course and is well protected from the effect of impact and abrasion by the resilient bituminous concrete surface. A considerable amount of the crushed stone was secured from the crushing of gravel. The gravel in this section is well loaded with boulders and large cobbles and in the crushing and screening processes materials both for the base course and top course were secured in one operation. The gravel did not contain stone enough to supply all of the ma-

terial required for the crushed stone base so that it was found necessary to provide a considerable amount of field and wall stone. Tests of the material in the gravel bank previous to crushing disclosed a deficiency of fine particles. The crushing process changed the character of the gravel very decidedly by the addition of a considerable percentage of fines. The use of a small amount of ground limestone with the screened gravel provided a very satisfactory mineral aggregate for the bituminous concrete top.

A Heavy Traffic Road

It is expected that this route upon its completion will carry a heavy traffic. There is no provision in the Rhode Island law limiting gross weights, axle loadings, and unit tire pressures of highway vehicles, and for that reason very substantial construction upon trunk lines is necessary.

The type of construction adopted upon this route has been found to be very satisfactory provided great attention is given the matter of stabilizing the sub-grade so that the pavement is not seriously injured by frost action. The possibility afforded by this type of construction of using a maximum of local materials and a minimum of imported materials appears to commend its use for projects far removed from railroads.

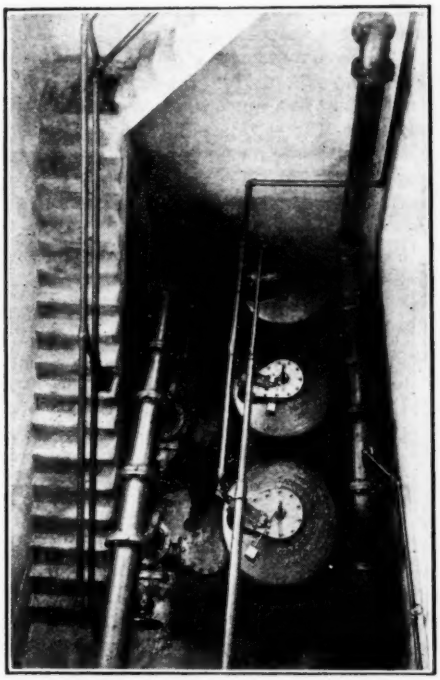
Insulating the pavement from the serious effects of capillarity where dense impermeable soils are encountered by the use of gravel and stone foundations appears to be effective.

BACKWATER FROM KEOKUK DAM DAMAGES FORT MADISON (IA.) SEWER SYSTEM

By L. B. Reynolds, Member of Firm of Burns & McDonnell Engineering Co., Interstate Bldg., Kansas City, Mo.

When the Keokuk dam was constructed, the city of Fort Madison, Iowa, located on the Mississippi river 24 miles above Keokuk, realized that not only had the small existing sewer system been damaged by raising the water level, but that facilities for the future sewering of the city had been impaired. In the summer of 1916 the city employed the firm, of which the writer is a member, to make a complete survey of the city and design an adequate sewer system and also determine the additional cost of such a system due to the raised water level in the river. The construction of the system was postponed due to the war, but contract was finally awarded in June, 1920, and construction was completed in August, 1922.

Before the Keokuk dam was built the stage of the river varied up to a maximum of 16 ft., a stage of 12 ft. being normal each spring with an extreme of 16 ft. once in 20 years. For two years after the dam was built the stage averaged 12 ft., but during later years the water level has been held at nearly 16 ft. The Mississippi River Power Co. reconstructed all the existing sewer outlets, raising them to elevation 12, and further offered the city $20,000 in settlement of damages.



VIEW LOOKING DOWN INTO EJECTOR PIT OF SEWAGE PUMPING STATION AT FT. MADISON, IOWA.

The damage caused by the higher river level manifested itself in two ways: first, the actual additional construction cost of the physical system needed to sewer the city, and second, the continual additional cost of operation and maintenance.

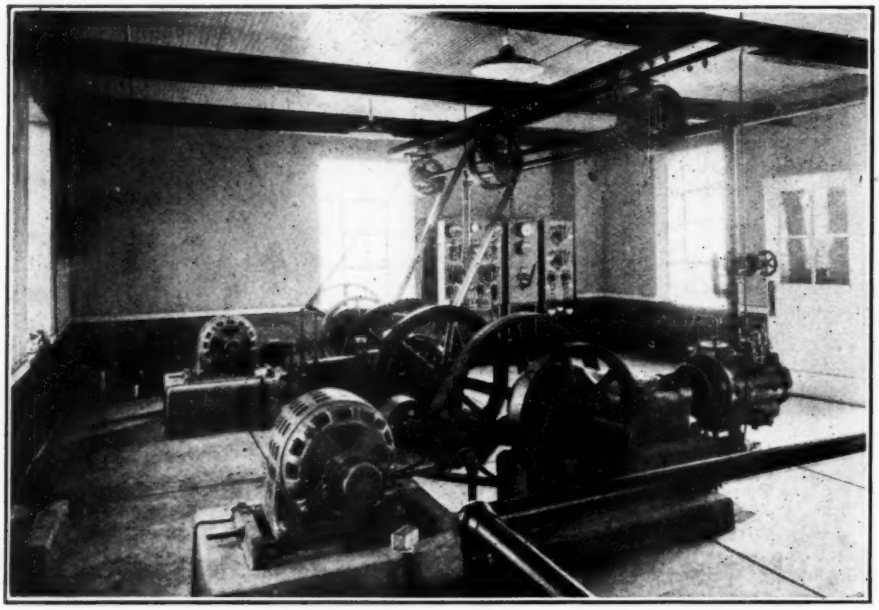
In view of the stage conditions of the river before the construction of the dam, it would have been feasible to plan gravity sewer outlets at elevation 12 and allow the extreme floods once in 20 years to interfere with the system temporarily.

Along the river is a low area which could not be drained by gravity even under these conditions and a small ejector pumping station would have been required to be operated an average of one month per year while the river stage was higher than the sewer outlet. No difference would have been necessary in the system serving the higher portion of the city, but some changes in location, size and grades of lines near the river would have been necessary.

The estimated cost of the proposed adequate system for the city under the conditions existing after the dam was built, less the estimated cost of a properly designed system under the conditions existing before the dam was built, represents the actual damages sustained by the building of the dam as far as first cost is concerned. This additional first cost was determined to be approximately $19,000.

No difference in operation and maintenance costs of the proposed systems before and after the construction of the dam was estimated with the exception of the ejector pumping stations. The head pumped against, as well as the quantity of sewage to be pumped, was much greater after the construction of the dam, consequently, the cost of power required was much greater. The supervision labor required, lubricants, repairs and other operating expenses were estimated and also the depreciation on equipment and the difference in annual charges against the two plants was found to be $2,760. The fund which would produce an annual return of this amount at 4 per cent interest, which was the interest paid by banks on time deposit and paid by the city on its own bonds, amounted to approximately $69,000.

The total damages caused by the raising of the water level due to the Keokuk dam was thus estimated at $88,000, including additional first cost and capitalized extra cost of operation. The damage suit hearing was postponed from time to time and finally in 1921 the Mississippi River Power Co. offered the city $50,000 in cash and the City Council accepted it rather than to incur the costs and suffer the delay of litigation.



VIEW OF MAIN FLOOR OF SEWAGE PUMPING STATION AT FT. MADISON, IOWA, SHOWING AIR COMPRESSING EQUIPMENT.

NOTES ON TWO NEW SEWAGE TREATMENT PROCESSES

By Louis L. Tribus, of Tribus & Massa, Consulting Civil and Hydraulic Engineers, 15 Park Row, New York, N. Y.

When households were served with water drawn in the old oaken bucket, or by the pitcher-pump, the quantity used, except on washday, was very moderate,

so that the old-fashioned cesspool in general, cared for the wastes.

Following the introduction of piped-water into houses, came the abandonment of the outdoor privy, somewhat so, the cesspool, with the construction of sewers as a substitute.

Sewerage systems are of course not alone the product of modern days, for ancient Rome and prior cities, were somewhat provided, but modern plumbing is responsible for the real problems to be solved.

The introduction of sewage into ponds and streams began to create nuisance, and to secure relief, sewage treatment became a new art.

Its early history was little but attempts to separate the solids from the liquid, and to large extent then, only for removal of unsightly and ill-smelling contents: crude sedimentation, rough screening and some slight filtration.

Gradually, sentiment has demanded better results; chemistry and bacteriology have been called in, and now, many methods are successful in practical separation, but few in satisfactory handling of the solids. An effluent can be secured of almost any degree of clarity and even purity, without entailing prohibitive costs.

Separation is but part of the problem, for the solids are generally putrescible, therefore offensive, and, have but a limited field for disposal. The processes that depend upon sludge digestion, to reduce the bulk and transform it to a non-niusance producing product, are bacterial and develop a humus of but slight fertilizing value, taking considerable time in the course of action. At best there is but little market for fertilizer from sewage sludge, or grease when that has been recovered.

Rapid separation through use of some coagulant (usually lime), produces a sludge of somewhat greater value, for it still contains the required elements of putrefaction wanted by certain forms of plant life, and lime which helps a sour soil. A large water content, however, calls for further separation by filtration or presses, or more costly yet, heat drying, while the small proportion of grease is a disadvantage.

Removal of sludge by the more recently popular activated sludge method is quite complete, so far as separation goes, but the water content still is large and not readily removed by ordinary processes.

Many combinations of chemical action have been tried with but scant practical success, yet faith and works will eventually secure the desired ends: viz. the production of fertilizer, where quantity is sufficient and market available at a cost justified by the return, or "land-filling," where such conditions do not obtain.

Two of the recent processes, neither of them as yet very persistently exploited, warrant mentioning, viz:

The McLachlan Process

The "McLachlan," where sulphur is roasted and its fumes passed through the separated sludge, the grease is practically eliminated and a semi-fibrous steadily dried product is obtained. By use of a paper-making type of roller press, the sludge is prepared for immediate bagging, shipment and use, without further treatment. It is claimed that the cost is comparatively slight.

The Selo Process

The "Selo" process takes its name from its four aids, "salt," "electricity," "lime" and "oxygen." When sewage sludge can be dried inexpensively without giving offense, or losing its organic elements, so that later putrefaction can be secured in the ground where plant life can get hold of its ammonia and phosphates, etc., such methods will be adopted, but until then the problem is still with us, unless the McLachlan fills the bill. The Selo makes no such attempt, but tries (and succeeds) to secure rapidly an inert, innocuous, readily hauled, inoffensive humus.

Chlorine is usually considered as a disinfectant, but it is not as chlorine that the good work is done. Strong chlorine added to water causes chemical reactions, producing "nascent oxygen" and "hypochlorite of sodium," both strong so-called "oxydizing" reagents, immediately destructive of all organic and bacterial contents of the water (sewage) to which they have access.

The Selo process calls for separation of liquid from solids; lime being the preferred coagulant to that end. Through the thoroughly akaline effluent, electricity is passed, causing the formation of as much nascent oxygen as needed to attain the degree of purification, (i. e., non-putrescibility), desired. To the settled sludge, low grade, common salt is added, electric current passed through and compressed air blown in to get the agitation needed and supply some oxygen. The salt is broken up and the reagents earlier mentioned, together with caustic soda, produced, completely in one hour of action, destroying all putrescible matter present, and developing a sludge that becomes

hard dry on filter beds in three or four days.

This compares with weeks for the drying of bacterial sludges on sand beds. The final removable material is good only for land fill. Flies, the pest of most sewage works give the Selo process a wide berth.

It is along such lines as these that sanitarians must look for greater advance in solving the sludge problem of sewage treatment. If by-products of value are to be retained, it must be at low cost of production; if not, final disposition must be secured at little expense and no untoward consequences.

There is a nice economic balance between what is worth saving and the cost of so doing; engineers and officials must weigh well therefore these plans when considering sewage treatment and final disposition.

SOLVING MUNICIPAL POWER PROBLEMS IN PARIS, MISSOURI

By F. H. Frauens, Jr., of W. B. Rollins & Co., Consulting Engineers, Railway Exchange Bldg., Kansas City, Mo.

The investigations made for the city of Paris, Missouri, a town of about 1,500 inhabitants, to determine the best method of meeting the necessity of caring for the increasing electric light and power load are interesting for the reason that they covered a period of years and included all possible solutions.

It is too often the case that a city, when confronted with such a problem, does not make any sort of intensive study of the matter, but frequently will purchase some new equipment, rather blindly, without knowing what the results of operation will be, or whether or not some other solution would have offered better or more economical service.

The city of Paris has been operating a steam plant for the past 15 years, the plant consisting at the present time of 2 100 H. P. Scotch Marine Boilers, and one 60 and one 125 H. P. non-condensing Corliss engines, driving single phase 1150 volt alternators. Early in the year 1920 the difficulty of handling the rapidly increasing load with this equipment was realized, and the city called upon the consulting engineers who had handled all of their improvement work for the past 15 years for advice and estimates of cost of a new plant.

It was found that for the year 1919 the total output had been 162,000 Kw. hours, the fuel cost (coal) of which was 2.43c per Kw. hour, the other operating expenses, including labor, repairs and supplies, being such as to make the total cost of operation 5.02c per Kw. hour.

Proposals to install new steam machinery, an entirely new Diesel oil engine plant, and a transmission line to secure Keokuk power were considered, but as conditions at that time were not favorable for the floating of a bond issue, or for construction work, it was decided to increase the working steam pressure from 100 lbs. to 130 lbs. and to let the old plant run a little longer.

In April, 1922, the matter was again taken up, records for 1921 showing that in that year 264,000 Kw. hours had been produced, or an increase of over 60 per cent in two years. The unit cost of producing this current was 7.06c, this increased cost being due partly to higher prices of coal, but largely to inefficient operation of the overloaded plant. In addition to this higher cost, several breakdowns had occurred to make the service unsatisfactory.

In 1922, five different plans were considered, as follows: A proposition to install two 185 H. P. full Diesel type oil engines, with generators, etc.; a proposition to build a 22 mile, 33,000 volt transmission line to secure current generated by water power at Keokuk, Iowa, and a proposition to build a 16,500 volt transmission line about 25 miles to a neighboring city where current from a central station equipped with steam machinery could be obtained. These three plans would each require that bonds be voted, as the plant would be owned and operated by the municipality. A proposal to allow the company operating the central station 25 miles away to build the transmission line, the city to purchase current at the city limits, was also considered. The fifth plan was the purchase of oil engines of the semi-Diesel type, which could be handled on a lease basis, monthly payments being made to cover the cost, no bond issue being required.

Local conditions had some bearing on the matter, one consideration being that it was thought advisable to keep the bond issue down as low as possible, as a bond election in Missouri requires a two-thirds majority, and the city officials were afraid that a large issue would be defeated.

In addition to the power plant necessary, a new distribution and street lighting system and some water works improvements were required, making the

entire bond issue necessary for a Diesel engine plant about $82,000. It was shown that the saving in operation of the new plant, over the cost with the present steam equipment, would more than provide the funds necessary for the entire bond issue proposed. It is a significant fact, however, that the large majority of citizens do not try to inform themselves about whether or not a matter of this kind is a good business proposition, but base their opposition or approval on snap judgment of the size of the bond issue. It was to overcome this condition that the officials at Paris extended their deliberations over a period of years, and kept the question before the people through the newspapers.

Mass meetings were held on several occasions to discuss the matter and in a further effort to convince the people that the right plan would finally be adopted, Prof. A. C. Lanier, head of the Electrical Engineering Department at the State University was brought to Paris to inspect the old plant, to review the consulting engineers' report and to make his own recommendations. His report, it may be said, agreed practically in all points with the consulting engineers' findings.

Outside of the question of the size of the bond issue, the main consideration was, of course, economy of production. There was not much variation in this item in the various plans, the estimated cost of production per kw. hour, including all costs of operation, maintenance and interest and sinking fund, running from 4.16c to 5.57c, these figures including the operation of the water works system also, it being figured this way because both plants were combined and the water works would need to be operated no matter which plan of securing current was decided upon.

In general, the following angles of each proposition presented themselves. No consideration was given a new steam plant, as it was recognized that a small steam plant could not compare with the other methods proposed. The Diesel engine plant embodied all the advantages of municipal ownership in that it would be located at home and was to be used only to serve its owners. Shipment and storage of fuel oil was not likely to cause any trouble and the fact that the operation of such a plant was efficient and reliable and the cost of producing current low strengthened arguments for this type of plant. The disadvantages were, as stated before, the large bond issue required, and the fact that it has been the experience of all cities that small plants are rapidly outgrown. The plant proposed would consist of duplicate units, each one able to carry a large increase in the present load, but it was felt that in a few years larger engines would be necessary.

The construction of a transmission line to secure power from the Keokuk dam would require a bond issue about $10,000 less than for the plant in town, and while the rates quoted were low, the power to be secured would be 25 cycles, making necessary the construction and operation of a sub-station to change the frequency from 25 to 60 cycles. While the part of the line to be owned by the city of Paris was only 22 miles long, the source of power would be approximately 125 miles away, the other lines being operated by several different companies. A contract could be secured for a period of ten years, and this method would make it reasonably certain that the power demands of the city would be provided for, for that period at least. There was also the chance of selling some neighboring towns an interest in the line.

The 16,500 volt line 25 miles to a neighboring plant would have given service over a relatively short line, and the low voltage would allow the city to serve some farmer connections along the route. The cost of constructing this line would be less than for the 33,000 volt line and sub-station, but the rates quoted for current were considerably higher than those quoted for the Keokuk power. It was also felt that any contract covering rates would be uncertain, as the regulation of these rates would be in the hands of the State Public Service Commission.

The proposition to have the 25 mile, 16,500 volt line constructed by the Power Company would mean that only a bond issue to cover the other work necessary would have been required, but the rates to be paid at the city limits were relatively high. The fact that the city could borrow money by means of a bond issue at lower interest rates than the private company could finance the line also entered into the matter.

No bond issue for anything except the new city distribution system and water works improvements would be required in case oil engines of the semi-Diesel type were purchased, as these engines could be secured on a lease basis, the city

making monthly payments on the equipment. It appeared that the saving in fuel, oil over coal, would be sufficient to meet these payments. The operation of these engines would of course be somewhat more expensive than that of the higher priced Diesel units.

As has been stated above, estimates showed that either one of these five methods would have resulted in enough saving in operation over the old steam plant to cover all expenses incident to the new construction; that is, if the present rates for water and light service were continued, the saving in operation would take care of the operation of the plant and of the bond issue. It was the intention of the city officials fully to investigate each proposition in order to secure the lowest unit cost based on the probable cost of operation and the overhead expense, spread over the probable life of the new construction.

However, before the final decision had been reached, another matter was brought up for discussion, namely, the question of a municipal ice plant. The ice plant question had been discussed at various times in former years, but nothing definite had been done toward securing this necessity. One result of the railroad strike which was in effect during June, July and August, was that for a time no trains were run through Paris, so that the usual shipments of ice were stopped. This caused the question of a municipal ice plant to be considered again, figures on first cost and cost of operation were secured, and it was finally decided to include this item in the proposed bond issue.

The proposed plant would be a 10-ton raw water ice making plant, to be built and operated in connection with the light and water plants. It is probable that the entire output will be sold at the plant, either at retail to citizens, or to a dealer for delivery, most of the supply probably going to the people through the dealer.

A bond issue for improvements as stated above, based on either a municipally owned transmission line or a Diesel engine plant, would have been between $100,000 and $110,000, and it was not thought advisable to submit such an issue to a vote.

This left either the purchase of oil engines on a lease basis, or the granting of a franchise for a privately owned transmission line as the only possible solution. The final decision was in favor of the purchase of two 200 H. P. semi-Diesel oil engine generating units, this decision being reached partly as follows: The main item of expense in the operation of a raw water ice plant is the power required, the monthly consumption during the months when the plant is running continuously being about 22,500 kw. hours. The cost of this current under the proposed contract with the central station would have been slightly over 3 cts. per kw. hr., while it was estimated that the cost to the municipal oil engine plant for the operation of the ice plant would not exceed 1½ cts. per kw. hr. This showed a saving of over $300 per month in favor of the local plant, and was one of the points which determined the final decision.

As the matter now stands, the City of Paris is starting on a program for an oil driven electric light plant to consist of two 200-H.P. units, a new distribution and street lighting system, additional filtration and pumping units, some extensions to the mains, and increased storage capacity for the water works, and an ice plant. The engines and generators will be purchased under a contract calling for monthly payments, these payments being provided by the lower cost of producing current with the new equipment as compared to the cost with the present plant. Funds for the other improvements mentioned will be secured from the sale of bonds.

The final decision of the city officials in this case was made after considerable study of the various points involved, and it is felt that enough facts have been obtained to secure the approval of two-thirds of the citizens for the proposed improvements.

It will be noted from the plans adopted that the principle of municipal ownership of water and light utilities will not only be continued, but extended to include the supply of ice. The light plant at Paris has received excellent support from the citizens, there being only three houses in the city (not counting shanties occupied by some of the colored population) not using electric current, and this in the face of unsatisfactory service in the past, due to the overload carried by the old plant. This support is the natural result of the careful operation of the water and light systems, under the direction of Supt. Geo. C. Blakey, with the support of the city officials.

THE TREND OF MUNICIPAL LEGISLATION AND FINANCE

(Editor's Note: Following is the full text of the report of the Committee on Municipal Legislation and Finance, presented at the annual meeting of the American Society for Municipal Improvements, held at Cleveland, Ohio, Oct. 2-6, 1922. The report was prepared by J. E. Barlow, City Manager, Municipal Building, New London, Conn., as Chairman of the Committee.)

The field which might be embraced in the work of the Committee on Municipal Legislation and Finance is almost unlimited, and any questionnaire of reasonable length, if sent out, would hardly bring forth adequate information. The report, which is herewith submitted, merely directs attention to some phases of the subject coming to the attention of the writer.

Finance

With the advent of the war and its aftermath, practically all cities have had to wrestle with serious financial problems. Some of the contributing factors which either decreased revenue or increased costs may be mentioned, as follows:

(1) Increased cost of labor and materials. For example, the expenditure for grade schools in New London, Conn., has increased in the last five years from $120,500 to $263,100; in the same period the police pay roll has increased from $25,600 to $86,800. The cost of coal for municipal purposes in Dayton, Ohio, increased in two years from $23,000 to $81,000.

(2) Loss of liquor license revenue.

(3) Increased cost of utility and other services furnished to the city. (It is interesting to note that the Legislature in Connecticut has provided financial relief for the street railways at the expense of the cities. The street railways formerly paid for and maintained the paving within car tracks and 24 ins. outside; now the State Legislature has relieved them of this obligation except for an 8-in. strip on each side of each rail.)

(4) The crime wave and epidemic of strikes have increased the burdens on police departments.

(5) There has been a demand for increased service in health and social welfare work, in recreation, parks, for better building codes and stricter enforcement thereof, etc.

(6) Tendency to shorten the hours in the police, fire and other departments. For example, in Dayton the firemen, in pre-war days, had one day off in five; this was changed to one day off in two, or 24 hours on and then 24 hours off duty; this greatly increases the number of men required to man the apparatus. In the same period the pay was increased from $80 to $135 per month. In Cleveland the public even voted an 8-hour day, meaning three complete shifts for the firemen as compared with two in Dayton.

(7) Great increase in motor traffic, both in pleasure vehicles and trucks, resulting in:

(a) Necessity for building more expensive road surfaces and bridges.

(b) Increased maintenance cost of streets.

(c) Increase in cost of handling traffic, necessitating more traffic officers, the maintenance of more traffic signals and the marking of safety and parking zones, the following up of auto thieves, stolen machines, etc.

Methods of Handling Increasing Financial Burdens

Some of the steps taken to meet these increased financial burdens may be mentioned as follows:

(1) Increase in tax rate and increase in the valuation of property.

An example of this is given in the following table, which is for New London, Conn. (population 1910, 18,000, and 1920, 25,000):

Year.	Tax Rate.	Grand Tax List.	Amount Levied.
1915-16	18 mills	$22,191,905	$ 399,454
1916-17	18 mills	25,140,103	452,521
1917-18	18¾ mills	28,649,032	537,169
1918-19	22 mills	29,370,694	646,155
1919-20	26⅞ mills	32,088,511	862,378
1920-21	33¾ mills	33,273,899	1,122,994

From the last column in the above table it will be seen that the amount of money due upon the tax levy of 1920-21 was nearly three times that of 1915.

In some states, as in Ohio, the state raises revenue by a millage levied uniformly upon all the taxable property throughout the state; this works to the advantage of those communities which keep a low valuation on property, with a correspondingly high tax rate. Those cities, on the other hand, such as Cleveland, which more nearly comply with the law requiring full valuation, bear an undue share of state taxation. Thus, if two cities in Ohio raise the same amount of money through the general property tax, but the first does it with half the valuation and hence double the tax rate, the second would have to contribute just twice as much towards the support of the state. This condition, which applies to county levies as well as state, has been no small

factor in defeating the successful operation of the Smith 1 per cent tax limit law in Ohio. In Connecticut, on the other hand, the state collects its revenue from the local taxing units in proportion to the average amount of money collected by each taxing unit during the three preceding years, without regard to tax rates or valuation of property.

(2) Increase in the rates of public utility service owned and operated by the city. In Dayton, the water rates were increased 50 per cent during the war period.

(3) Increase in various licenses and permit fees collected by the city for building permits, for special privileges, etc.

(4) Inauguration of new taxes such as inheritance tax, income tax, special business or occupational tax. Thus, Cincinnati inaugurated an occupational tax in 1919, from which is derived an annual revenue of $500,000.

(5) Increase in registration fees for motor vehicles and returning part of same to the political subdivision where the vehicle is owned. Ohio increased the auto registration fee and returned part of the revenue derived to the political subdivision where the vehicle was owned. Dayton, Ohio, derives a revenue of about $110,000 per year from this source.

(6) Tax on gasoline and sign boards. For example, the state of Connecticut now imposes a tax of 1c per gallon on gasoline; this indirectly relieves cities, as otherwise the state might have to raise more money from local tax on property.

(7) Local license fees for motor vehicles.

(8) Special assessments on property benefited to pay for improvements, instead of paying for same from general taxes. The practice varies widely in different parts of the country. In Ohio the property owner pays 98 per cent of the cost of the street pavement in front of his property, while in Connecticut the general practice is for the entire cost to be paid from general taxes.

(9) Inauguration of more economical administrative methods, centralizing responsibility, the installation of better accounting systems, giving intelligent financial control, the adoption of detailed budgets, the appointment of municipal purchasing agents with requisition system, stores accounts, etc.

Legislation

The progress in municipal legislation in any one year is hardly discernible, so it is necessary to look back over a period of years to discover the tendencies and advancement made.

"Home Rule" for cities, which has been agitated for many years, has, in some instances, been granted in a very large measure by state legislation, as, for example, in Ohio. In drafting new municipal charters, there has been a marked tendency to lessen the number of officials to be voted for. There has likewise been a noticeable endeavor to centralize administrative responsibility.

Initiative, referendum and recall provisions which, only a short time ago, were considered radical theories, are now embodied in many charters and readily accepted. Proportional representation has been included in several charters, noticeably in the new Cleveland charter, which takes effect one year from next January. Direct primaries and non-partisan ballots are now the general thing in new municipal charters.

Many cities have adopted zoning laws, tenement house laws and building laws which a few short years ago would have been considered a transgression on private property rights.

City planning boards have been created with broad general powers and more attention is being given to the orderly development of the city. The scope of the city planning movement has been enlarged and we now have regional plans being developed.

Several cities, including San Francisco, Seattle and Detroit, have extended their municipal ownership activities to include street railways, the ultimate outcome of which will be watched with interest.

There is a growing appreciation of the fact that to conform to a sound financial policy, bonds should not run for a longer period of time than the life of the improvement which its proceeds purchase, and that the bonds should be either serial or sinking fund issues, thus being gradually retired during the life of the improvement. In Ohio this policy has been put into statute form. Under such a plan of financing, the municipality is in effect paying for the improvement as rent, much the same as does the individual who buys and pays for a home through the Building and Loan Association.

In Ohio, and possibly other states, legislation has been enacted which allows the creation of districts, comprising several or parts of several political subdivisions, for the purpose of paying by special assessment for projects which benefit the district and which could not be carried

out by any one of the political subdivisions alone. Thus, a sanitary district for the construction of a sewerage system or a sewage disposal plant can be created to serve several communities. Or, a district can be created to provide protection against floods, as in the Miami Conservancy District, which comprises parts of nine counties, centering at Dayton, Ohio. This latter project will cost approximately $35,000,000, paid for by special assessment upon the property within the district.

James Bryce has forcefully called attention to the fact that the government of our American municipalities was the weakest link in our democracy. However, changes have been taking place gradually. The old town meeting of New England was very democratic, but as the town grew it became unwieldy. Likewise the old complex bicameral form of municipal government, patterned after our Federal government, has seemed, in many instances at least, to have proven unsatisfactory, due partly to lack of centralized responsibility.

After the great storm in Galveston in 1900 the so-called commission form of government came into existence. This combined the legislative and administrative functions in a small elective council consisting usually of five members. When adopted later in Des Moines it was given much publicity and became known as the Des Moines plan. This idea spread rapidly, and in a decade and a half it had been adopted in nearly 300 cities.

The commission plan, however, did not solve the municipal problem. The next general step has been the development of the so-called city manager plan. This is copied from the large private corporate organizations, the small elective council corresponding to the board of directors, and the city manager, appointed by the council, corresponding to the general manager of the corporation. He carries out the entire administrative functions of the city government, the council being the legislative and policy determining body. This plan started in a preliminary way in Staunton, W., Va., in 1908, but gained no momentum until adopted in Dayton in 1913 after the disastrous flood there. It has now been adopted in 287 cities, distributed through 38 states. The most noticeable addition to the list is, of course, Cleveland, with a population of 800,000, where, however, it does not go into actual operation for another year. The other cities in Ohio having this form of government are: Akron, Ashtabula, Cleveland Heights, Dayton, East Cleveland, Gallipolis, Lima, Middletown, Painesville, Sandusky, South Charleston, Springfield, Westerville and Xenia.

The city manager plan of government was discussed at the annual convention of this society ten years ago. There was some sentiment expressed that such discussion bordered on the political, but the writer could hardly be expected to review recent municipal legislation without touching upon this outstanding development.

MODERN WATER FILTRATION PLANT BUILT AT ASHLAND, KENTUCKY

By Donald H. Maxwell, Principal Assistant Engineer, Alvord, Burdick & Howson, Consulting Engineers, Hartford Bldg., Chicago, Ill.

Ashland, Ky. has a population of about 15,000 and is situated on the Ohio River. The city was formerly supplied with water by a private company whose pumping station is located in the adjoining town of Catlettsburg. The Catlettsburg supply is taken from the Ohio River and passed through settling basins before being distributed to the consumers. In 1918, the City of Ashland purchased the water distribution system within the city, and has since then built its own pumping station and filtration plant which is now in successful operation. The new water supply is taken from the Ohio River immediately above government dam No. 29. The filter plant has a rated capacity of 2 2/3 million gallons per day, which it is estimated will provide for the requirements of the city until about 1940.

Cost Kept Down

Owing to the unfavorable conditions of labor and material supply at the time and the anticipated hazards of construction involved in the tunnel and dry well, difficulty was experienced in getting bids at reasonable figures. At the first letting in July, 1919, a single bid on the building construction was received, and this was more than double the engineer's estimated cost. This bid was rejected, and the work readvertised, and a special effort made to interest responsible bidders. This time two bids were received, both of which exceeded the available funds.

It was then decided to curtail the work so that it would fall within the funds available. It was believed that the intakes, low lift pump, pit and coagulation basin could be financed, and their con-

struction would enable the city to supply its consumers with water equal or superior to the Catlettsburg supply and at a much less cost. The work was again readvertised and this time five bids were received. The low bidder at the previous opening again put in the low bid, but although fully half of the work had been eliminated the low bid was only 20 per cent below that for the entire plant. It was evident that the hazard involved in the dry well construction was partly responsible for bids being high.

Cost Plus, Sliding Fee Contract

It was the opinion of the engineer that the bids were still higher than the reasonable cost of the work and the city was advised to assume the risks involved by letting the work on a cost plus sliding fee contract, in which the city's interest was protected by giving the contractor an inducement to economy. Such a contract was drawn up by the engineer in consultation with the Water Board and Joseph E. Nelson & Sons, general contractors, who were awarded the contract and successfully carried out the curtailed work, with a saving to the city of approximately $22,000, or nearly 25 per cent below the low bid. This is the more noteworthy on account of the unusual number of unreasonable freshets in the Ohio River in the fall and winter of 1919-20. These unexpected floods greatly delayed the work and added to the cost. The contract proved mutually satisfactory.

Intakes

Two intakes are provided, at different levels. The dam ordinarily ponds water to a depth of about 15 ft. at the water works, and one intake is located on pile cribbing near shore at a depth of about 2 ft. below normal pool level. This intake consists of a 24-in. W. I. pipe, 10-ft.-6 ins. long, placed lengthwise with the stream, with 1-in. perforations at 2-in. centers. To provide for the contingency of extreme low water at times when the gates of the dam are open, a second suction line is laid on rock below the river bottom and connected by elbows to a 20-in. perforated steel pipe intake 25 ft. long lying on the river bottom and pointing downstream. The perforations are 1-in. holes, 2-in. centers, in the upper half of the pipe only. The perforated pipe is anchored by tie rods and collars to the suction line.

Both suction lines are 20-in. cast iron. pipe laid on an up grade to the pumps. The pool level suction line is 200 ft. long and the low water suction line 275 ft. long. For protection and to have the pipes reasonably accessible for repair, both are carried through the steep bank of the river in a reinforced concrete tunnel of horeshoe section, 6 ft. 3½ ins. inside height and 120 ft. long. A manhole large enough to allow of passing a length of 20-in. pipe gives access to the tunnel at the river end, 17 ft. above pool level. The shore end of the tunnel is closed with a water-tight bulkhead through which the suction pipes pass. Access to the tunnel through this bulkhead is provided by an 18x24-in. boiler manhole. The tunnel floor is 6 ins. above pool level and drained to the river through a pipe provided with a gate valve.

Low Lift Pump Pit

The low lift pumps are placed in a circular reinforced concrete pit at the shore end of the intake tunnel with floor 3 ft. above pool level. This pit is 20 ft. in diameter by 44½ ft. deep below the high lift pump room floor, from which access is had by means of an electric elevator and a spiral staircase.

The low lift equipment consists of 3 centrifugal pumps rated at 2½ million gallons per day against 65 ft. total head. Two pumps are motor driven and the third direct-connected to a gasoline engine for reserve service. Very compact arrangement was secured by placing the three pumps in a row and taking suction from a common header of special castings at right angles to the two intake lines. A motor driven priming pump serves also as a sump pump.

Coagulating Basin

The low lift pumps deliver to a mixing chamber which allows for a mixing period of 25 minutes at rated capacity of 2 2/3 million gallons per day. The mixing chamber is an uncovered rectangular compartment at one end of the reinforced concrete coagulation basin and is provided with vertical over-and-under baffles of wood, the passes being 2 ft. by 2 ft. 6 ins. in plan. At rated capacity the maximum velocity through the mixing chamber is 1.4 ft. per second, and the minimum velocity 0.82 ft. per second.

From the mixing chamber the water flows into either of two coagulation basins. These basins provide for 4¾ hours sedimentation at rated capacity of 2 2/3 million gallons per day. Both basins are arranged with central baffle wall, for two passes. The first pass is provided with four 8-in. blowoffs from hopper bottoms sloping 30 degs. to the horizontal. One

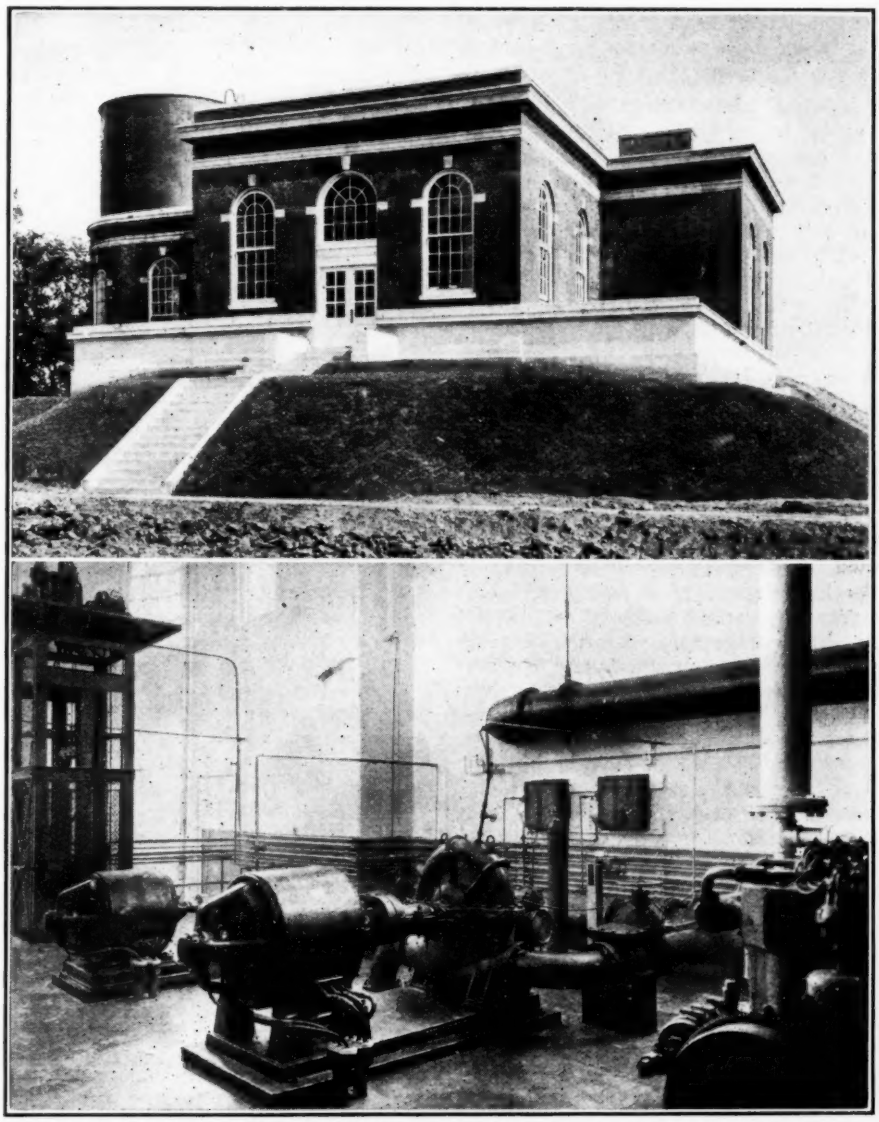
central blowoff is provided in the second pass. Coagulating basins may be operated singly, in parallel, or in series.

Temporary Plant

Part of the high lift pumping equipment was purchased and installed in a temporary wooden enclosure on top of the coagulating basin, and the plant put in operation in the spring of 1920, furnishing the city with water that had been treated with alum, and given approximately eight hours' sedimentation, and chlorinated The results were found to be very satisfactory, and the plant was operated in this manner until the present summer. The quality of the settled water, bacterially, was excellent. The results from the turbidity standpoint were also excellent, even during the floor stages of the river. The water was clear, but lacked the sparkle of filtered water.

Completion of Plant

Additional funds having been provided meantime by bond issue, bids were taken in the fall of 1921 for the completion of the plant. The contract was let to the



VIEWS OF ASHLAND, KY., FILTER PLANT AND INTERIOR OF HIGH LIFT PUMP ROOM.

Ellington-Miller Co., general contractors, for the filter building, and to the International Filter Co. for filter equipment.

High Service Pump Room

The high lift pump room and filter plant are combined in a single structure built on top of a 220,000 gal. clear well, part of the clear well roof forming the pump room floor, through which the suction pipes extend to sumps. The high service pumping equipment consists of two motor driven and one gasoline engine driven centrifugal pumps, the latter being for reserve service. These pumps are of 2½ million gallons per day capacity, and operate against total head of 275 ft. A wash water pump is also located in the high service pump room.

Filter Plant

The four 2/3 million gallon per day filters are over the clear well and arranged in pairs on either side of an operating floor at elevation 557. This floor is about 4 ft. above extreme high water in the river and 13 ft. above pipe gallery and high lift pump room floor. All of the filter building walls, including those which enclose the low lift pump pit, are carried up to the operating floor level. The only opening below this elevation is the freight door, which is 9 ft. lower, but this door is provided with a hinged steel bulkhead that can be made water-tight in emergency. The freight floor is also over the clear well and communicates by hand power elevator to the third floor chemical storage room where the mixing tanks are located.

The intermediate floor, on a level with the filter operating platform, accommodates office, laboratory, lavatory, orifice boxes, venturi meter stand, and from a gallery overlooks the high lift pump room below.

The wash water tank is located on the roof over the low lift pump pit.

The plant was completed and put in operation early in June of this year, under the direction of Mr. W. S. Patton, Water Works Superintendent.

Other Improvements

The water works improvements have been carried out by a Water Commission of which Mr. E. C. Means is chairman. In addition to the new pumping station and filter, a ½ million gallon reinforced concrete reservoir has been added to the system, the old 1½ million gallon reservoir has been roofed over, additional feeder mains have been laid and the existing mains cleaned, putting the plant in first class condition at an approximate cost of $200,000.

Upon the completion of the plant all berms were sodded and the remainder of the station tract of several acres seeded. The trees along the river have been trimmed, slopes graded and the site made a most attractive park.

Cost

The cost of the plant as partially completed in 1919 was as follows:

General contract, including river intakes, tunnel, dry well, coagulation basin and grading	$73,900	
Valves and high service pipe connections	2,025	
Pumps and venturi meter	13,817	
		$88,742
The cost of the deferred work was as follows:		
Filter building, clear well and grading	$35,664	
Wash Water Tank	1,588	
Filter equipment	14,670	
Pumps	3,489	
Piping, moving pumps and miscellaneous	4,158	
Wiring and moving switchboard	1,438	
		$61,007
Total cost completed plant		$149,749

This work was carried out distinctly to the city's advantage in the following respects:

1st. The cost-plus contract on the initial construction, drawn to protect the city's interests, saved the city $22,000 compared with the lowest lump sum bid offered.

2nd. Partial completion of the plant for temporary operation until additional funds could be voted enabled the city to discontinue the purchase of water at an early date, and temporarily (for two years) supply better settled water from its own plant at much less cost.

3rd. Deferring the construction of the filter building resulted in this part of the work being let at a very substantial saving, as shown by the following comparison of low bids on filtration equipment, the same bidder in both cases:

Filter equipment, 1919.....$18,300
Filter equipment, 1921..... 14,670

Credit for these savings is largely due to the personnel of the Ashland Board of Water Commissioners. This board is composed of three of Ashland's most successful business men, Mr. Means, the chairman, being an engineer. The commissioners have directed the affairs of the municipal water works in a strictly business-like manner.

The engineering on this work was handled by Alvord, Burdick & Howson, under the personal direction of Mr. L. R. Howson.

FEATURES OF STREET AND SIDEWALK DESIGN IN VARIOUS CITIES

(Editor's Note: Following is the text of the report of the Committee on Street and Sidewalk Design presented at the annual meeting of the American Society for Municipal Improvements. Mr. E. R. Conant, Surveyor of the Department of Highways of the City of Manchester, New Hampshire, was chairman of the committee and Messrs. G. A. Crayton and S. Q. Cannon were the other members.)

In making a study of street and sidewalk design certain fundamental principles are to be considered, the most important being utility, appearance, safety, drainage, and arrangement. That full advantage can be taken of streets and walks sufficient widths should be provided for traffic and crowns and grades provided that will least impede traffic. The relative position of roadways, walks and parkways enter into the utility and appearance feature, and the location of trees, lamp posts, hydrants and poles can be arranged either to mar seriously the appearance of a street or, if the posts, railway poles, etc., are of ornamental design, and properly located, they with the trees or shrubbery can add to the general appearance. The type of curbing and method of laying it adds or detracts from the general appearance. The safety features require consideration of safety islands or zones. For foot traffic the elevation of the curb at crossings should be properly adjusted and with the present fast moving traffic proper curvature of the curb at corners is required. So that surface water upon the streets can be properly taken care of, the arrangement and type of catch basins or inlets is important. Again the arrangement and layout of roadways, sidewalks and grass plats should be considered with a view of widening the travelled roadway area if found necessary to accommodate increasing traffic.

It might be said that only of comparatively recent date has the subject of street and sidewalk design been attempted in a scientific manner, for comparing the data received in our answers to the questionnaire sent out by the committee, it is noted that with the exception of recent layouts in the older cities, street design in them is far behind that followed in the newer cities. Not long ago comparatively narrow streets were suitable for horse drawn vehicles and with the introduction of street car lines, space had to be provided for them, but not until the automobiles came into existence did the engineers and municipal authorities realize that the laying out of streets to care for motor traffic was a real engineering problem that had to be treated in a scientific manner.

It is not at all improbable that surface street car lines, except under certain conditions, will to a very large extent, in the near future, be eliminated, and a new method of transportation will arise which will utilize some type of motor bus and undoubtedly new requirements for roadway area will then be required. Today there are cities and towns located between large cities, between which there is a very heavy truck traffic, which are forced not only to design and adopt types of streets for their local needs, but also to provide for the through traffic. We recognize the fact that types of thoroughfares for a residential city may differ from those required for a mill or manufacturing city. Again, topography enters into the design of our streets so that it is very difficult, if not impossible, to recommend fixed types of thoroughfares that may be wholly standardized but from the answers received from 60 odd municipalities a very good idea is obtained of the best practice now in vogue and this report attempts to give a brief summary covering various features of street and sidewalk design for various parts of the United States and Canada.

Methods for Determining Widths of Roadways

Considering design of streets upon what basis can we determine the proper and necessary width for the traveled roadway? Replies to this question from officials of municipalities show conclusively that the width of roadways should be based on the number of lines of traffic which they must accommodate and while but a very few cities report that they give consideration to the density of traffic as an aid in establishing the necessary number of lanes, but instead generally allow certain widths for each line of traffic, yet the committee feels that a study of the present and prospective amount of traffic is very important and urges that more study be made of this particular feature in establishing present and prospective needs for vehicular traffic.

Widths of Lanes of Traffic

Analysis of the replies received would indicate that for each line or lane of traffic a width of from 7 to 8 ft. is necessary for motor vehicles parked at the curb and from 8 to 10 ft. for vehicles moving.

The greater width is for truck traffic, the lesser for automobiles so that for industrial or business sections a somewhat greater average width should be adopted for each lane of traffic than for the residential section. A reasonable width for each moving lane of traffic should be not less than 9 ft. and at this time it need not be above 10 ft. For parking vehicles 8 ft. is ample. Space for street car tracks should be from 8 to 9 ft. for single track and from 18 to 20 ft. for double track.

Widths of Roadway

With the intensity and character of traffic known the total required width of the traveled roadway is readily ascertained. It is observed that the newer cities of the West, South and Canada have generally wider thoroughfares than are found in the older cities. For streets where two lanes of traffic are required, the width of 18 to 20 ft. is pretty well established. For three lanes of traffic 27 ft., for four lanes of traffic 36 ft., and where a single track exists 10 ft. is allowed and for a double track, 10 to 20 ft.

In the larger cities radial and main thoroughfares should be provided for and generally the distance between these main thoroughfares for residential sections should be from 1,500 to 2,500 ft. apart and for industrial and business sections they can advantageously be laid out for 600 to 800 ft. apart, this spacing being the practice carried out in the cities from which the committee received answers to their questionnaire.

Lanes or Back Streets

Lanes or back streets are of much importance and directly enter into the utility feature. With a system of lanes, especially with a city laid out with the rectangular system, lanes are of special value. The sanitary sewers can be placed in them. Many of the unsightly poles from the street are placed in the back streets, deliveries to residences can be made, and collection of garbage and rubbish as well. Garages constructed on the back of lots can be entered from back streets much better than from the front. The widths of these back streets or lanes should not be less than 18 ft. and preferably from 20 to 22 ft. for for they must accommodate two lanes of traffic and provide space for poles.

Classification of Streets

Classification of streets in some instances are spoken of as major, secondary and minor streets, in other cases as boulevards,main and minor system and lanes. When it comes to considering boulevards local conditions and topography enter into each individual case and where extensive boulevards are planned, the lanscape gardener should be a party with the engineer to lay it out. Your committee does not attempt at this time to standardize the layout of boulevards.

Sidewalks

There must be considered the proper width for foot traffic. Sidewalks in many instances in the past have been laid out irrespective of actual or future needs. The width of sidewalks should be determined by the intensity of traffic, and, from the replies received, the best practice at this time is to adopt a width of from 5 to 6 ft. for residential sections, and from 10 to 15 ft. or more for business sections, the widest walks being called for in the retail business section. The width for walks through parkways or boulevards are often laid out for appearance as well as to meet actual needs, and the widths noted above are not applicable to these conditions.

Grass Plats

The introductions of grass plats or parking space, especially for residential sections, is highly important. Not only does this space offer a suitable location for trees, poles and hydrants, but also enters into the general appearance of the highway and also affords an opportunity, when properly laid out, to permit of widening of the traveled roadway without the acquisition of additional land. The width of a plat where trees are planted should not be less than 5 ft., and the maximum width is fixed for local conditions and by the width of the right of way.

In laying out sidewalks and grass plats a number of cities allot from 1 to 2 ft. on unoccupied space between the sidewalk and the property line when the grass plat is next to the curb. In a minority of the cities from which data have been obtained, the sidewalk is placed next to the curb, and the area between the sidewalk and the property line alloted grass plats. This is with a view, in some instances, of prospective widening of the roadway.

Planning of Streets, Thoroughfares and Lanes

The general layout of streets, lanes and main thoroughfares is a study for Planning Boards or Commissions and is more for the City Planning Committee to report upon than Committee on Street Design. After the streets or their general location are laid out, the width that should be required is for our Committee to study and, as noted above, this study should be based upon the amount of pres-

ent and prospective traffic to be accommodated. In many cities widths of streets are determined by ordinance, some of which are of long standing and the dedication of the streets fix the widths without any regard to the amount of traffic which they will be required to accommodate.

Safety Zones

The general practice is to paint the pavement with lines which designate the area or zones where vehicular traffic must give way and look out for foot traffic. These lines may mark zones where street cars stop or they may mark crossings for foot traffic from one sidewalk to the other. The zones where street cars are approached are usually 6 ft. in width and of proper lengths, and a safety walk from the middle of the zone to the sidewalk on the side of the street where the zone is marked off is advantageous. In a number of cities a raised area way is constructed either by a plank platform about 4 ins. high or a platform of concrete. In other localities posts or stands connected with ropes are installed. However, the question of safety islands or zones is a somewhat mooted one, and at this time there appears to be no general practice. In a majority of cases the zones or islands are marked with paint, and in at least one state, and perhaps others, laws have been passed requiring safety zones, under certain conditions, to be 7 ft. in width.

Sidewalk Crossings

There is a tendency to get away from the step at the curb to the street at street intersections, especially where the foot traffic is heavy. In the replies received there were one or two instances cited where the reverse is reported. The method followed out is to have either a gutter underneath a flagging or iron plates with the pavement brought up with a warped surface to meet the curb grade. Another is to have the inlets to catch basins on each side of the corner and the pavement brought up solid to the curb. Where steps are provided, the height or maximum drop should not exceed 6 ins.

Radii of Curb at Street Corners

Before the introduction of the automobile and motor trucks, when vehicular traffic was carried on with a much lower speed, a 6, or at most 8, ft. radius curb was considered adequate. Under present conditions in new layouts the radius of the curb in residential sections should not be less than 10 ft. In business sections, from 10 ft. to whatever limit can be introduced, according to width of sidewalk and roadway. For alleys, 5 to 6 ft. radius is sufficient. Some cities have established the radii as being equal to the width of sidewalk at the street intersections, and where the width of sidewalks is greater on one side than on the other, the maximum width would be taken by determining the adopted radius of the curb. Other cities regulate the radius of the curb by the width of the roadway, the narrower streets calling for a greater radius than wider thoroughfares.

Catchbasin Inlets

Catchbasins should be connected directly to sewer through manholes; that is, an individual pipe should be carried to the manhole from each catchbasin or inlet, and they should never be connected direct to the sewer except at manholes. They are generally located at street intersections, but where necessary to increase the number, intermediate inlets may be located in the middle of the block. One reply received from Winnipeg states that the catchbasin inlets are almost entirely located in the center of the block, the grades of the streets being flat. The gutters run to the center of the block and pavement at street intersections is leveled with the sidewalk. The older systems of conducting water from the gutter into the catchbasin was to have gratings in the gutter and perhaps a small opening cut in the curb. Every engineer knows these gratings are a nuisance in that they are continually being clogged up, and many an overflow has been caused by their becoming unserviceable, due to leaves and trash clogging the small openings in the grate bars. Modern practice provides for the entrance of the water into the catchbasin through openings either cut out of the curb, or, better, through openings in castings set in the sidewalk, flush with the curb, under which the catchbasin is constructed, and at street intersections there is no reason why more than one catchbasin should be carried from the gutter on either side to the one catchbasin, and with the latter plan the cross-walk for pedestrians can be brought to the level of the curb at the corner. Many cities have the catchbasins located at the center of the curb radius. In some cases they are placed on the property line back of the sidewalk, but neither plan appears as favorable as to have the catchbasins located back of the end of the curb radii.

Crown of Streets

The proper amount of crown is dependent upon the grade, width and character of paving, and to some extent upon the method of providing for run-off of water in gutters. Generally the grade varies di-

rectly with the width and inversely as the function of the grade of the street. A quite general practice is to fix the crown from 1/60 to 1/100 of the width, depending on the grade and character of service, and from the replies received from one or two of the larger cities, the crown is frequently the width of the street divided by 60, less 1 in. Again, in one of the prominent cities the crown expressed in hundredths of a foot is 1½ times the width of the roadway. Other formulas noted is to allow ⅜ in. per foot for one-half the width of street, also 1 in. for each 5 ft. of width.

Analyzing the answers in our questionnaire as regards the amount of crown, the following appears to be the general practice where grades of streets are normal and where the surfacing of the pavement is concrete, brick, bituminous or surfacing of light nature:

For street width of
20 to 22 ft., the amount of crown 4 ins.
24 to 28 ft., the amount of crown 5 ins.
30 ft., the amount of crown 5½ ins.
32 to 42 ft., the amount of crown 6 ins.
45 ft., the amount of crown 7 ins.
48 to 52 ft., the amount of crown 8 ins.

For rough-surfaced streets such as granite block the crown should be increased from 20 to 25 per cent; for macadam or gravel, 50 to 75 per cent, and where the grades of the street exceed 4 per cent the amount of the crown can be reduced in proportion to the grade, from 20 to 40 per cent.

Gutters

Where very flat grades are encountered the slope of the gutter is often made much steeper than the general crown of the street, and in a number of instances cited the slope or rake for the gutter may be as heavy as 1 to 3 ins. to the foot. This prevents pools of water extending out in the street from the gutter, which might occur if the uniform crown of the street was carried to the curb, and especially where there may be slight inequalities in constructing the street surface. Again, a little increase in longitudinal grade or slope in a flat street can be brought about by having this gutter slightly deeper at the catchbasin than it is in the middle or end of the block.

Arrangements of the Roadway, Sidewalks and Park Space with a View of Prospective Widening of Roadway

Special instances can be cited, but undoubtedly the best plan followed is where the municipalities have a Planning Board or Commission, who, with the City Engineer, or other official having charge of the highways, co-operate and have such laws and ordinances passed that permits only the laying out of new streets and thoroughfares based upon a plan that not only will accommodate present traffic, but provides for future growth. In many municipalities such laws and regulations are in force which fix the building line back from the street line, so that if the necessity for street widening occurs, it can be done by acquiring additional land, but not requiring the removal, or setting back, of buildings. Not only is it necessary for the municipalities to have control of the layout of streets within the city limits, but it is very well to have a law which will enable the city to have control of the layout of streets as developed by real estate agents and land promoters within a certain defined distance outside the city limits, this being done for the reason that, as the city limits are extended, there will be a regularity and proper uniformity of layout that will conform to the city's street extensions when the limits are extended.

The arrangement of parking space and sidewalks can be so carried out that in case the roadway requires widening, the extra width can be taken from the park or sidewalk space. One instance where a paved street was widened without changing the crown or tearing up any of the pavement, and yet not increasing the depth at the curb, is of interest.

The paving at the new curb line was started at the regular height or distance below the top of the curb and sloped to the edge of the old pavement, making a gutter several feet from the edge of the curb. Before this was done it was thought by some that the method would be undesirable, but it worked out so successfully that a number of streets in the same city were widened in this manner. This method appears rather novel, but might be used in special cases.

Location of Lamp Posts, Poles and Hydrants

In many cases poles, hydrants or posts are set just back of the curb, but a better practice would be to have them set back from the curb a sufficient distance so that vehicles in parking will not hit them. We know that some automobiles have overhanging tops, and when parking upon streets with considerable crown, there is danger of hitting posts or poles if they are not set back a little distance from the curb. This need not be more than 1 or 2 ft. Where park space or grass plats exist,

lamp stands or posts are generally set in the middle of the grass plat.

In conclusion, the committee feels that a start has been made in ascertaining what appears to be the most modern and best practice as regards street and sidewalk design.

VALUE OF PRESENT TESTS FOR GRANITE IN DETERMINING PROBABLE WEAR IN PAVEMENTS

By Clarence D. Pollock, Consulting Engineer, Park Row Bldg., New York, N. Y.

In studying the present tests for granite in determining its suitability for paving blocks it may be well to study the history and development of these tests.

At first no tests were made, but the blocks were cut, paved and simply submitted to the service test. Architects had required the test for crushing strength of granite which was to be used in building construction. Some of the engineers thought that a test should be called for and knowing of the architects' test, they inserted this in the specifications. Various minimum requirements were used, varying from 15,000 lbs. per sq. in. up to even 30,000 lbs. per sq. in. When the minimum requirement was much over 15,000 lbs. it was found that many granites which had proved very satisfactory under the service test for long periods were barred out. A study showed that no very definite relation could be found between this test and the behavior of the granites under the actual traffic conditions. In 1915 the American Society for Municipal Improvements adopted specifications with tests for impact or toughness and the abrasion test for French coefficient of wear including minimum requirements for moderately heavy traffic and heavy traffic.

Impact and Abrasion Tests

At that time these tests seemed about as fair as any which had been tried, although they were not devised for this purpose. Since then, from observation of results obtained in laboratories and results in the pavements, it has been difficult to find much relation between these tests and the actual service test in the streets.

These two tests were designed to measure the relative resistance to impact and wear of broken stone for use in macadam road pavements, and they do not fit in with the conditions surrounding the use as paving blocks, to any great degree.

More Practical Tests Needed

The object of this paper is not to advocate the abandoning of all tests, but to encourage experimental study for the developing of more practical tests by calling attention to the defects of those now used in the testing of granite for paving blocks.

In the toughness test the sample is very small, 1 in. diameter and 1 in. high, and great care is necessary in making the sample or there will be wide variation in results. A little carelessness in making the test specimens from the same sample may result in an error equivalent to 25 per cent of the total range of all granites used in the Eastern portion of the United States. This chance for error detracts greatly from the value of the toughness test aside from the fact that it is a test that does not approximate the wear conditions in the street.

High Probable Errors in Present Tests

In the test for French coefficient of wear, also, the error may be as great as 25 per cent of the total range of the granites, due to the method usually used in breaking the test pieces with a hammer, which may start incipient fractures and also because of the irregularity of the shapes of the pieces for the test.

Machine-Made Test Pieces

The Bureau of Public Roads has developed a machine for breaking out the test pieces by pressure, which obviates the fault of incipient fractures and produces more regular shapes, but this cuts down the range of results on the various granites and makes it more difficult to differentiate the various granites.

This test does, however, show whether there is any real disintegration or not. The old idea that discoloration indicated disintegration has been thoroughly exploded. Discolored or "sap" stone may in many cases show a greater strength than the clear stock from the same quarry. Real disintegration will show up in this test and herein lies its chief value in giving the relative strength of the material from the same quarry, although it is not of much value beyond this in indicating how it will wear when paved in the street.

Improving Test for French Coefficient of Wear

With the object of improving the present test for French coefficient of wear for granite block pavements, the laboratory of the Bureau of Public Roads has made modifications in the methods of preparing the test pieces for the Deval abrasion test as previously stated, the samples being broken into small cubical blocks by means

of a machine instead of by hand. The machine consists of a 20-ton forcing press such as is used in automobile repair shops for forcing the gears from shafts. This press is equipped with both stationary and movable knife edges and it has sufficient power to break a standard 5-in. granite block. This machine breaks the block into small cubes rapidly and much more accurately than can be done by hand and in addition avoids the danger of starting incipient cracks in the stone. In other words, the test pieces have good, clean, fairly regular faces and are approximate cubes.

Abrasion tests upon these fragments showed a greater coefficient of wear than the old method, but the results checked much better, although the range in values obtained with the different granites was much more limited than with the hand-broken specimens. In order to increase this range, Mr. Jackson tried a modification of the abrasion test which was proposed by Messrs. Scofield, Mattimore and others, as follows: A number of longitudinal slots 1/16 in. each in width were milled in the abrasion cylinder, and the test was run on granite from 12 representative quarries, making 2 to 3 tests on each kind of granite. Tests were also run on these same granites, using the present method, and the results were compared. The elimination of the dust cushion gave lower coefficients of wear but the maximum variation of check tests was much less. In general, the coefficients of wear were somewhat over 2 points lower than with the present standard apparatus.

The total number of tests made was not sufficient to draw definite conclusions as to what minimum coefficient should be specified, but the maximum variation in check tests was sufficiently low to indicate that this was a step in the right direction. It is urged that more tests be made along this line and if they prove as consistent as those already made by the Bureau of Public Roads and several other laboratories, it may be possible to select definite minimum requirements to be used with these modifications in this test, which will be an improvement on the present standard, so that this test may be much more satisfactory than at present. This test is valuable as a means of proving whether a granite is disintegrated to any extent or not.

Accelerated Traffic Test

Several years ago the Bureau of Public Roads constructed 19 sample sections of granite block pavement from different quarries, using different forms of filler and cushion and tested them by an accelerated traffic test, which consisted of a machine having a frame carried upon rails which were parallel and on either either side of the sample sections of pavement. These rails were supported firmly by concrete stringer or beams, which also formed the sides of the pavement sections being tested. The subgrade was natural earth on a side hill having a gentle slope. Upon the subgrade, 18 ins. of rammed cinders were placed and then 8 ins. of Portland cement concrete was deposited. On this foundation was constructed the various cushions and the test sections of granite pavement. In the frame of the testing machine were cast iron discs having a diameter of 4 ft., which ran freely in the frame. This frame was drawn back and forth over the test sections by means of a cable. This is the nearest approach to a service test which has yet been devised. However, it was not possible to draw very definite conclusions from the results obtained, as there was more or less settlement of the concrete foundation, probably due to the large amount of cinders underneath it, and the narrowness of the pavement between the concrete foundations of the rails. It would seem as though some such form of practical test could be devised which would not be so cumbersome or expensive but that the laboratories could afford to use it.

An important point to be borne in mind in devising a better test is not so much how individual blocks will act under the test as how they will act when combined, as in a pavement with the usual joint spacing and the different fillers in the joints.

A simple form of accelerated traffic test would be the ideal one and approximations of this are what should be aimed at in securing a more practical test.

Only One Present Laboratory Test of Any Value

In summing up the value of the laboratory tests now used to determine the wear of granites in granite block pavements, the conclusion is reached that the test for French coefficient of wear is the only one of value and the principal advantage of this is to determine if disintegration has progressed sufficiently to render the stone unsuitable for use in pavements, provided the coefficient of the normal clear stock of that quarry is known. The value of this test will probably be increased by using the modifications as were tried by the U. S. Bureau of Public Roads.

In the test for abrasion it would be advantageous to use the percentage of wear directly rather than the French coefficient, as in the lower percentages of wear the French coefficients change greatly for small percentage changes.

The foregoing paper by Mr. Pollock was presented at the recent annual meeting of the American Society for Municipal Improvements.

HOOVER ON THE PUBLIC AND THE COAL INDUSTRY

(Editor's Note:—Following is a summary of an address by Herbert Hoover, Secretary of Commerce, before the Salesmen's Association of the American Chemical Industry at New York City on September 12, 1922.)

The favorable progress of legislation for the creation of a National Coal Commission fully empowered to get to the bottom of the troubles in this industry is the first step in one of the most vital problems we have. I have been earnestly recommending such a commission for the last three years, because I do not believe great solutions are to be found out of emotional denunciation, but out of sober scientific examination.

Present Condition Very Bad

When the public can be made the victim of infinite loss and suffering by such disagreements as we have witnessed; when the whole nation can once every two years or less be pushed to the edge of the precipice of want and commercial collapse; when our public utilities, hospitals, schools and kitchens are dependent upon short rations of non-union coal; when the Federal government is forced to interfere with business and transportation to secure even this movement to essential points; when we are brought to consideration of price fixing against extortion in peace time; when hundreds of thousands of workers not only in the industry but outside of it are thrown into skimping and starving; when the nation is made to suffer the shame of Herrin and rampant crime that has followed in train of strikes —then some examination of our industrial sanity is called for.

There is much in the industry that needs public ventilation, but more important than this, there are two distinct lines of problems for which constructive solutions are needed, that can only be furnished after more considered investigation. The first of these problems is the employer-employe relationship; the second is economic reorganization of the industry.

Fair Play Hard to Establish

The present relationship of employer and employe in the industry comprises a periodical national danger, because, with national organization and national disagreement, it means national stoppage. In the end, the issues of the struggle are consciously or unconsciously imposed by pinching the welfare of 99 per cent of the community, who are not parties to the quarrel. And through subsequent prices the public pays the bill. The public therefore has a right to a voice in this whole business.

Surely fair play can be obtained for employer and employe in our civilization without war on the public. But it is not sufficient to shirk the issue by saying that there must be fair play. We must discover the machinery by which fair play can be delivered to all sides. We must have continuity of production in this essential commodity under righteous conditions of employment if we are to maintain the welfare of the nation at all.

Interruptions to Production

I believe such a commission would find that collective bargaining, conciliation, and arbitration upon their present basis of organization have in sequence broken down in this industry, as witness the long stoppages in production which all these processes are supposed to end. In this connection, if we examine the inside workings of this recent strike, we will find situations new in industrial relations. Under freedom from the restraint of trade laws the workers' organizations have grown in strength, solidarity and devotion; they have shown able leadership, whereas the organization of employers for the purpose of collective bargaining has been to a large degree destroyed by the action of these very laws. Without entering into the history or rights or wrongs of this phase, the bare fact exists: That the recent agreement in the bituminous industry was determined by only 15 per cent of the employers, and this minority's decision controlled the whole.

From the public point of view, these things are only of importance as they contribute to interruption in production. The greater proof that the conception of collective bargaining in this industry has failed upon its present basis to secure any assurance of protection to the public is the famine in coal.

Federal Laws Have Failed

The Federal laws on conciliation have failed to obtain any results for peace. The

conception of arbitration is a settlement based on mutual agreement to abide by the decision of a third party, but this is now refused "on principle," for in this industry the workers consider that arbitration always results in compromise and that this is compromise with their bread and butter. Thus all of the old conceptions of mutual settlement in the industry have failed. We may well preserve the old methods of peace but of a certainty they must be better organized, and we need something more that will bring a positive insurance of peace to the public. Nor is the organization of employers on a national basis the answer, for in such case, while collective bargaining might proceed more smoothly, the public could well take alarm that the costs of any bargain can be passed on to the consumer. Therefore such bargaining must be controlled in the public interest, even if it served to prevent stoppage.

The Public Right

There are a great many rights that have grown up around these industrial relations. Workers have a right to organize to protect and improve wages and conditions of labor. They have a right to collective bargaining. They have a right to strike. They have a right to refuse to join such organizations. They have a right to work without intimidation and assault. Employers have a right to refuse to recognize such organizations. They have a right to lockout. They have a right to keep open shop. No one seriously denies any of these rights, but a lot of people are overlooking a superior right. That is the right of the public to a continuous supply of its vital necessities and services upon terms fair to the employer and employe. When these various rights infringe upon the public right, then the dominant right is public right.

I do not propose to anticipate the conclusions of the Commission as to methods. My desire is to emphasize the vital importance of its mission.

A Multitude of Evils

Nor can the problem be solved solely by treatment of employment relations. There is essentially the need for constructive thought that will devise remedies for a multitude of evils that give rise to great industrial wastes, and breed much of the employment difficulties. They bring great burdens upon the public, workers and operators.

Aside from employe relationships, most of the economic demoralization lies in the bituminous, as distinguished from the anthracite, industry, and my discussion hereafter refers to bituminous alone. This industry, indeed, functions very badly. Some state glibly that it will work itself out if left alone. But it must be borne in mind that it has not been left alone in the past and the present situation is in large degree due to legislative interference. The control of combinations among operators without such restraint among employes, the rules of artificial car distribution, the state legislation of various sorts, and other acts have a great responsibility for the present condition. I am not here questioning the necessity of these measures, but their influence in the situation must not be overlooked and they must be either supplemented or amended by wise provisions, if we are to have coal peace.

Bituminous Industry Over Developed

There are 8,000 bituminous mines with an annual capacity of 850,000,000 tons—300,000,000 capacity beyond our national needs. The over-capacity in the industry results not in the permanent closing of some mines but in the operation of all of them more or less intermittently. Thus the working personnel is held attached to each mine in daily hopes of employment. In the best year of their history the bituminous mines operated an average of only 249 days in the year, out of a possible 308, whereas in most years the average is about 210, as against about 295 days in England and over 300 days in Germany. If we subtract the mines which are operating regularly for certain metallurgical and railway supplies, we find that the situation is even worse, for the remainder of the bituminous mines are probably operating an average of less than 180 days, or over 120 days lost time out of the year.

There are 2,500 too many bituminous mines and 200,000 too many people in the business. This waste of labor, of capital, and of coal levies tremendous tribute on the entire country. Investment in the industry is extremely speculative. Distribution costs are excessive. The operators vibrate between bankruptcy and high profits. And the public in ordinary times is paying far more for its coal than would be necessary from a stabilized industry.

The perpetual labor difficulties are but one of the inevitable by-products of this poor organization. Labor is struggling on one side to set up remuneration based on such day's pay, and such piece-work rates, as will give a standard of living, from 60 per cent of time employed. Labor

is thus honeycombed with the worst of stimulants to unrest: insecurity of employment. At the same time, men who have the opportunity to work full time in regularly operating mines earn returns far above the average income of our most prosperous farmers and other workers. There can be no solution either to the operators or to the workers as long as this condition continues.

The largest contributor to over-expansion of the industry is now the almost regular biennial quarrel, with its undue prior demand for coal and its subsequent shortage with temporary high profits. This results in intermittent operation of many mines at a loss in the lean period between strikes or threats of strikes. The war demand and profits have also contributed this over-expansion. Beyond this the non-union mines in the south, with a capacity of over 300,000,000 tons per annum, being able to secure a lower wage level than the union mines in the north, at times of sharp competition are enabled to undersell northern coal, and are gradually causing the industry to migrate from the north to the south, with consequent over-equipment in the north.

Annual Shortage of Railway Cars

Intermittent operation also arises in the chronic annual shortage of railway cars because a sufficient car supply for the short-peak period is economically impossible to the railways. A bad system of distribution of cars to mines by the railroads contributes also, because under the present methods the fly-by-night operator has a right to demand his quota of cars in times of good demand and paralyzes the ability of the systematic mines to comply with their contracts or to maintain regular operation. There is inadequate storage at points of consumption to take up slack from seasonal and daily intermittent production. The marketing machinery itself creates intermittency because of the incessant shifting of contracts from one mine to another. Furthermore the high unit wage basis encourages absenteeism and thus at times an irregular supply of labor; there is a perpetual rain of small and local strikes, all directly and indirectly contributing to intermittent operation—for all of which the public pays. What we want is greater continuity of production as a basis for smoother relations and lower costs.

The Storage Problem

Aside from relief from national stoppage in production from strikes and lockouts, there are proposals of constructive and practical remedies which should be investigated and which do not lead to socialism and destruction of the American freedom and initiative. For instance, an extra annual storage of 20 per cent of railway consumption would equalize the seasonal fluctuation. Larger storage is possible by the railways at those times when public demand for coal is slack instead of competition by the railways themselves with the public for coal, and thus for the use of cars, at the annual period of car shortage. A system of car distribution that would not itself break into regular operation would help. Larger storage by public utilities would assist and would give greater security to the public.

A contributing remedy that will need the most earnest consideration is the possibility of permitting the co-operative system of marketing developed by the farmers to be applied by such mines as wish to adopt it, under circumstances that would assure competitive conditions. Such an arrangement would decrease distribution costs, would give more regular flow to orders, would get better car distribution, would decrease transportation, would enable the laying down of coal in storage at points of consumption, and would consequently give more regular operation with reduced working costs. More accurate statistics of capacity, production, consumption stocks, and prices would greatly promote stability and would be in the true interest of the operators who are now blamed for much that is not their fault.

It has also been proposed, although I have doubt as to practicability, that there should be a penalty in higher wages for short-time employment. Proposals are also made for a basic wage with a participation in the realized price of coal.

Of dominant importance, however, is the fact that the whole employe and employer relationship requires reform if we are to secure a stable industry. Much friction would of course disappear if there were less intermittence. The instability of these employment relations themselves form a vicious circle of quarrels. Collective bargaining has a fundamental value in the industry in the maintenance of standards of wages and conditions of labor, for otherwise the workers, because of competitive drive for low costs, would never have arisen from the impossible conditions of years ago; but the breakdown of true collective bargaining in the biennial conflict, the constant local violation of agreements, and the multitude of

small strikes are themselves proofs that it needs better organization, and public participation with guarantees.

Some Want to Maintain Present Conditions

I recognize that stabilization of the industry, or anything that lends stability to the industry, is opposed by a small minority of speculative operators who use the periodically disturbed production to reap a recurrent harvest. It would be opposed on the other side by some of the more narrow-minded labor leaders who contend that their object in all industry is to reduce the number of hours of actual labor to some minor fraction of the whole year, or whose ambition is to drive the nation to socialism in desperation for coal, or who deny the public right to any voice. However, I believe that the constructive men on both sides are in full agreement that we must have a broader and better solution than results from the truces of the past few years.

These periodic wars in the industry are, therefore, in part symptoms of a disease. But before we treat this disease we must have a more accurate diagnosis. We must have adequate, accurate information from which to weigh the different causes. We must be able to apply to all the test of fact. From such an understanding we should be able to return this industry to sanity. The proposed commission has the greatest opportunity for constructive work since the war.

The public demands results; it is sick and weary of periodic warfare and futile attempts at solution.

POLLUTION OF WATER SUPPLY SOURCES

By Edward E. Wall, Water Commissioner, City of St. Louis, 312 City Hall, St. Louis, Mo.

Twenty-five years ago or so, in discussing water supplies for cities and towns, the weight of expert opinion seemed to incline towards the prevention of pollution of streams from which communities drew their water, rather than towards sanctioning the application of purification processes to water taken from contaminated sources. At times the debate over this question grew acrimonious and many arguments pro and con were adduced, which afterwards were proven to be entirely unfounded.

One favorite stand-by of the opponents of purification by chemical treatment was the old belief in the self-purification of streams—that a certain distance below the point where sewage or other waste was dumped into the stream, the water would be found to be as free from contamination as it was above that point. As eminent an engineer as Captain Eads said of the Mississippi river at St. Louis: "I think before the water runs half a mile it has a tendency to purify itself; the main drainage of the city affects the quality to a certain extent but I apprehend that only a few miles below the city we find the water as pure as we do above it."

In those days the danger of using untreated water from contaminated sources was not realized as it is today, nor were there any standard methods of determining whether or not a water was safe for human consumption. As late as 1900 the contention of St. Louis that Chicago, by turning its sewage into the Mississippi river, was poisoning the water supply of the southern city, was vigorously contested, and experts employed by Chicago sought to prove that all noxious effects had disappeared long before the polluted water reached the mouth of the Illinois river. Many experiments were made to determine whether or not disease germs survived a journey of one, two or three hundred miles in the sluggish current flowing towards the Mississippi, but the most conclusive of all tests showed that the water supply of St. Louis was very materially affected, for both the typhoid and the general death rates steadily rose after the opening of the Chicago drainage canal.

It was not until St. Louis installed purification of its water supply in 1904, that the death rates began to decline, and soon the question of the contamination of the Mississippi river with Chicago sewage became a dead issue.

Within the last 20 years the study and practice of the purification of water supplies at one time advanced to the stage where the degree of pollution of the raw water became a matter of little concern, as it was generally believed that a safe and potable water could be supplied from grossly contaminated sources. The rapid development of the science of water purification proved of inestimable value to all cities and towns dependent on surface waters for their supplies, as it at once seemed to remove from further consideration the questions of restricting or prohibiting the pollution of water courses, of policing drainage areas, and left each community free to discharge its untreated

waste into the source of water supplies for neighboring communities. This absolution from responsibility for the effects of unmoral actions, this policy of leaving each individual or each aggregation of individuals to take care of their problems regardless of the causes of their difficulties, is bound to prove demoralizing and eventually to lead to far worse troubles than the initial ones. Thus it is now, that the pollution of many sources of water supply have reached or are nearing the point where purification processes are either becoming so expensive as to be an almost prohibitive drain on the funds of the community, or more often are proving inadequate to safeguard the public health.

This brings us face to face with the question as to how far should the cost in money and health be allowed to accumulate in the case of one city or town because of the defilement of a stream by residents of another place above, before restrictions should be enforced on the offending parties.

The community directly above the aggrieved town may plead prior pollution of the stream before the water comes to its doors, holding with entire truth that the degree of pollution which would be produced in a pure stream by their sewage would not be beyond the allowable limit, but because of the general noxious condition of the stream, other people above them should be held in some degree responsible for the objectionable situation and should be made to bear their equitable portion of the cost of remedying the evil.

Obviously the task of apportioning the responsibility and proportionate share of this cost among the numerous offenders would be no easy one. Another reason why such a procedure would prove impracticable is that the science of water purification has not yet advanced to the point where a grossly polluted water can be certainly and continuously converted into a harmless potable water. The only other practicable alternative is to prohibit the pollution of water supply sources beyond the point where it is easily possible to produce a safe water for domestic use and at a reasonable cost. Wherever the limit of pollution was reached in any case, no contaminating waste should be allowed to be discharged into that water without prior purification.

The United States Public Health Service has lately published some results of an investigation into the self-purification of the Illinois river, (Fire and Water Engineering, Vol. LXXII, page 357) which show clearly the steady decrease in bacterial content until the stream is again contaminated with the sewage of Peoria and Pekin. Because of the gross pollution of this river with Chicago sewage and because it has no large tributaries, it affords an excellent opportunity for observing the effects of natural purification in the case of a highly contaminated stream, but in itself offers no especial information applicable to impure streams in general.

This investigation along with others of the same kind serves to show the general fact that if left without reinforcement, the impurities in all streams diminish as the water flows away from the source of contamination, just as also impounding the polluted water of streams in reservoirs brings about self-purification through the changes which occur in the organic matter, and the causes, whatever they may be, which shorten the life of bacteria and reduce their multiplication.

But the information available is not sufficient to enable us to determine how many miles any given stream must flow in order that its water may purify itself sufficiently, either that it is safe to use in its natural condition, or that the pollution is reduced to a point where its purification by the ordinary methods is practicable.

Neither can we set a definite limit on the extent to which a water may be contaminated and still be safe as a source of water supply, which it is practicable to purify.

The American Water Works Association through its Council on Standardization is endeavoring to determine from the results of operating purification plants, the actual loads carried by these plants, and whether it is possible or practicable to increase these loads and to what extent.

The great variation in the character of purification plants, the diversity of the methods used and the degree of skill exercised in their operation present a problem which will require long and careful study before any decided conclusions can be reached.

For example, the methods of purifying water supplies range from plain sedimentation, with or without filtration, to coagulation, softening and sedimentation followed or not by filtration and disinfection, with various modifications of detail, such as the use of preliminary filters or the

omission of softening or disinfection or both, all of which is complicated by the time element, often a very important factor.

Some places rely upon simple sedimentation in storage basins, others hasten settlement by the use of coagulants, but do not filter, usually depending upon disinfection with hypochlorite or liquid chlorine to protect the health of the community. Then there are the slow sand filters and the rapid sand filters, to each of which may be added, as an adjunct, preliminary or roughing filters. At some plants softening is necessary, or at least is practiced, bringing another factor into the purification process, and introducing new problems.

No matter how well designed any plant may be, nor how well-fitted it is to care for the local conditions, the skill with which it is operated is a matter of prime importance. Many of the smaller plants are sadly hampered by lack of funds, and their managers, no matter how capable or conscientious they may be, are forced to allow important matters to go by default. Therefore data from various plants must be interpreted with due allowance for the manner in which each plant is conducted.

But regardless of the type of the plant, the methods used and the manner of operation, there is one conclusive test which may be applied alike to all, and that is the test of use. Wherever the people served are satisfied, and shown to be healthful by the absence of water-borne diseases, it may be taken for granted that the purification of water at that place is efficient and all that could be asked for in treating the quality of their raw water.

Potable water supplies are being produced from waters containing a maximum of 23,000 B. Coli per 100 c.c., 1,200,000 colonies bacteria per c.c., 500 p.p.m. color, turbidity of 6,000 p.p.m., with disagreeable odors and tastes arising from contamination from untreated wastes from gas plants, oil refineries, coke plants, pulp mills, oil wells, sewage and organic matter.

While the water furnished the consumers from these grossly contaminated sources may be safe for domestic use and satisfactory to the majority of the users because they have grown accustomed to it, and have never known anything better, it would probably be very unpalatable to the visitors from other places which have an unimpeachable water supply.

A general standard may be set for a safe water for domestic use, just as the U. S. Treasury Department has established a standard for waters used by common carriers, but any attempt to place a limit on color, hardness, taste, odor, etc., would be abortive, since these characteristics vary with localities where each community sets up its own standards.

Casual observation of the data on highly contaminated sources from which satisfactory potable water is produced might lead one to conclude that methods of water treatment would improve as the quality of the raw water deteriorated, so that year after year communities could continue to obtain safe water from the same source regardless of conditions.

While the science of water purification has made remarkable progress during the last 20 years, it is far from being a certainty that it can keep pace with the growing pollution of the smaller streams.

If it were possible to produce water fit for human consumption from the worst polluted sources, still the item of cost would have to be considered—at some stage of the game a point would be reached where the cost of treatment would mount up to such a figure that the prevention of pollution would be cheaper and more practicable than purification. It does not seem likely that conditions will ever be allowed to arrive at this stage, because of aesthetic reasons if for no others.

Still there are even now some places drawing their water supplies from sources where the limit of pollution, so far as existing facilities for purification are concerned, is almost at hand, so that it is only a question of a comparatively short time until some action must be taken to prohibit the unlimited discharge of untreated waste into sources of water supply.

SOME THOUGHTS ON STREET WIDENING IN BUSINESS DISTRICTS

By C. E. Grunsky of C. E. Grunsky Co., Engineers, 57 Post St., San Francisco, Calif.

When the lands were subdivided on which the big cities of this country are now located, and certain portions thereof were dedicated to public use as streets no one had in mind that presently the elevator would come into use and that the intense use of ground space as exemplified in skyscrapers was a possibility. The experience of the world fixed the width of a good serviceable street in a large city at 60 to 80 ft. and necessity for street widths of 120 ft. or more, except

as boulevards, was rarely recognized. It is natural, therefore, that the traffic capacity of the streets of our cities is now insufficient. This would be still more so, in business districts if the horse had not been crowded from the street by the automobile. It is safe to estimate, that the automobile makes at least twice the speed of the horse, and that it occupies only one-half the space on the street that would be occupied by horses and wagons or horsedrawn trucks of equal capacity. The traffic capacity of the city street may, therefore, be assumed to have been increased about fourfold by the advent and general use of the automobile.

But, it is also true that where the automobile is used to render the transportation service which should fall to the street car, or to the elevated and subway trains, the demand upon the street by the individual who goes from his residence to his business by automobile and who perchance parks his car on the street for the greater part of the day, is much greater than need be.

If the present demand for street surface in relation to building area could have been foreseen when our large cities were laid out, it is likely that some such plan as that adopted for Washington would have been followed. Streets of the first class would have been made 120 to 150 ft. wide, with the understanding that only so much of the street would be paved and made available for traffic as required from time to time, leaving the paving of its full surface and the shifting of sidewalks back to the building line for the future. Under such a program, the property owner would have long been left in as complete possession and use of a fine garden plot in front of his premises as though he *had* been the owner thereof in fee.

Now, we are confronted with an embarrassing situation calling for a remedy. The skyscraper has come to stay. The intense use of the downtown lot is demanded and our American people have not the courage to say nay. On the street the parking of cars is restricted or forbidden. Other parking space is hard to find or entails a burdensome expense. Sidewalks are being cut down in width wherever property owners will consent, but frequently this results in deficient sidewalk area. Two-story streets are talked about and subways, particularly such as will facilitate the crossing of busy streets by pedestrians, also movable sidewalks and the like to overcome special difficulties but nothing that can fully take the place of the wider street, which can not be secured in the downtown business section of the big city owing to the prohibitive cost of acquiring the necessary ground space.

There will be many cases, however, where it is not too late to take steps to overcome the evils which have resulted from the lack of foresight, and two ideas are here suggested that may be helpful in solving some of the problems which appear to many impossible of solution.

Acquiring Land in Advance of Its Use for Wide Streets

In addressing a small group of citizens at Stockton, Calif., a short time ago the writer threw out the suggestion that Eldorado street in that city should be widened by acquiring at once, while the city is still young, a strip of land along its west side at least 60 ft. wide; but with the understanding that wherever the ground is already in use, as where covered by a building, a lease will be given to the present owner for any desired term of years not exceeding 25, at a rental of say 5 per cent per annum on the price paid by the city for the land and 7.5 per cent on the price paid by the city for improvements on the land. Opportunity would thus be afforded for the gradual adjustment of business to new conditions and the value of improvements at the time of dispossessing the original owner would be minimized. In this particular case it is recognized that Stockton must soonor or later provide itself with a wide north and south street and none other appears better adapted to fill all requirements than Eldorado street. The actual widening of the street under such a program, might have to be deferred for the full period covered by the longest leases to present owners of the strip of land required for the widening. If the city does not adopt some such program it will still, no doubt, get along in some fashion; and, when 25 years have rolled by, the needed improvement will then quite likely be found impossible of accomplishment or will in any event be very costly.

This plan of acquiring property years before the actual carrying out of an improvement is one under which many of the difficulties in the way of widening streets could be overcome, particularly when the price paid for any land taken is made the basis of the rental that will be required from its former owner.

Acquiring Sidewalk Space Inside Property Line

The other thought is along similar

lines, but relates to the acquisition of rights at the street level only, without disturbance of the building line for upper stories. There are no doubt many cases where the widening of a street due to the character of the buildings which line both sides would be impracticable but where it would be possible to acquire a 20 ft. right of way for sidewalk purposes inside of the property line. Wherever this can be done, even though the taking of possession may sometimes be long deferred, the surface of the street available for vehicular traffic can be widened sooner or later. This arrangement would have the incidental advantage, too, of giving the pedestrian shelter from sun and rain. The architectural arcade effect, moreover, can be made pleasing. It is hardly necessary to discuss the benefits that would result from such a modification of the common present day plan of making provision for both pedestrians and vehicles outside of the building line and the only question to be considered is the feasibility of any specific project. Where the required space is in use by a business concern which would abandon it with reluctance, the purchase of the right of way might well be made subject to a long time lease with rental determined as a fixed percentage of the price paid for the easement so that, if not now, at least after a quarter of a century, which is a short time in the life of a city, possession thereof could be taken. There will be many cases where the suggested arrangement would be welcomed, where the advantage to the storekeeper of the improved sheltered display facilities would be recognized. There is hardly a large city in the country where some arcades can not be found and where some of the stores with large floor space do not themselves provide sidewalk arcades. In carrying out any such project the plan could here, too, be followed of fixing the rental of temporarily retained floor space at 5 per cent on the amount paid for the easement.

WHY NEW YORK CITY NEEDS STORE-DOOR DELIVERY

An address on store-door delivery, which has been earnestly advocated by The Merchants' Association, was delivered recently by Mr. W. H. Connell, Assistant Manager of The Merchants' Association's Traffic Bureau, before the Society of Terminal Engineers, and is here reprinted from the Sept. 18, 1922, issue of Greater New York, the Bulletin of the Merchants' Association of New York.

What Store-Door Delivery Is

The store-door delivery system has long been established abroad. It consists of the delivery from freight terminals to the premises of the consignee or in the reverse direction, at an established public rate of merchandise in transit. This delivery constitutes a part of the continuous movement of the freight to the consignee and in the reverse direction and is included in the original shipping directions of the consignor duly covered in the bill of lading of the originating carrier's agent. It introduces order and economy where disorder and waste are now prevalent.

In discussing the subject Mr. Connell said:

"The Industrial Bureau of The Merchants' Association of New York, which Association I have the honor and pleasure to represent, informs me that there were 22,981 manufacturing establishments in the Borough of Manhattan in 1919, employing 519,647 persons and producing products valued at that time at about three and one-half billion dollars.

Important to New York City.

"From the same source I learn that there are approximately 7,500 wholesalers in Greater New York, the vast majority of whom are located in Manhattan and whose inbound and outbound shipments move largely in freight service. I am also advised that there are about 48,000 retailers in the Borough of Manhattan engaged in distributing goods, the greater part of which require freight service at some period in their distribution.

"To handle the greater part of the freight required by these manufacturers and distributors, there are upon Manhattan Island at the present time only 65 railroad freight stations. Is it strange, therefore, that times of great business activity, congestion or lack of motion due to unsystematized trucking of inbound or outbound shipments occurs at our terminals?

"Distribution deals with the movement, storage and sale of products from one agency to another until they reach the consumer, and the merchant in most cases looks upon the railroad as the most important movement or transportation agency. From his point of view there are three links in the transportation chain, each of which is vitally related to and dependent upon the other; namely, delivery to the carrier, transportation by the

carrier, and delivery to the consumer or consignee. The first and particularly the last links are the ones with which store-door or direct delivery must deal.

Three Needs to Be Filled

"From the merchant's point of view, store-door or direct delivery in order to be really effective must supply three fundamental needs, namely:

1. Safe delivery,
2. Quick delivery,
3. Delivery at a reasonable cost.

"The results of the ineffective supply of the first requirement are partly manifested in the volume of concealed loss and damage claims which merchants must file against the railroads. The term 'concealed' used in classifying claims means that the loss or damage was not visible at the time the goods were delivered to the carrier for transportation or when they were delivered to the consignee's truckman for movement to the consignee's store or other receiving point.

"During this year the volume of concealed loss or damage claims paid by rail carriers on shipments to or from New York averaged $7,500 per month. That the railroads consider the truckman an important factor in the handling of freight shipments is indicated by the questions asked in the standard form for investigating claims of this class. Some of the questions asked of the shipper are:

On what date was the shipment delivered to the truckman?

Was the shipment delivered to the truckman before or after twelve o'clock noon?

Was the delivery made to the carrier by your own truck? If not, give name of trucking company.

Give name of driver in either case, if known.

Would Reduce Losses

"Similar questions are asked of consignees. When the answers indicate that the goods were in the possession of the truckman overnight or a sufficient length of time to afford an opportunity for pilfery, the claim is invariably declined. I believe that an effectively organized, managed and operated system of store-door or direct delivery would insure to our merchants a greater percentage of safe deliveries to and from the carriers' terminals than is being secured at the present time. I know of no disadvantages which the merchant would suffer under an effective system of store-door delivery in connection with this need.

"The second fundamental need of the merchant is to secure quick delivery to or from the carriers' terminals. Engineers, perhaps better than any other class of men, recognize the fact that a straight line is the shortest distance between two points. Also the further fact that, circumstances and conditions being equal, freight movement over a straight line will reach its destination in a shorter period of time than via a circuitous route. I believe that an effective system of store-door delivery would insure the movement of freight from rail terminals to consignees' receiving points in a much straighter line and with a consequently lesser delay than is now being experienced.

Delay at Rail Terminals.

"Under the law the carrier is obliged so to place goods in its warehouse that they are reasonably accessible to the consignee, open to his inspection, and permitting their safe and convenient removal by the consignee or his agent. The carrier is also required to afford the consignee a reasonable time within which to take delivery. The last figures available indicated that approximately 60 per cent of the inbound freight handled at our Manhattan pier stations was not delivered within less than 48 hours after its arrival here. While this does not seem to be a very serious delay, when the volume of traffic requiring handling at our pier stations is taken into consideration it will be found that it is a most fruitful cause of congestion at our piers. The necessity for embargoes against our pier stations during the war period, due to slow removal of freight from our terminals, is so fresh in the memory of most handlers of freight shipments that further comment thereon is unnecessary.

"Previous investigations into the desirability of establishing store-door delivery and consideration of the several plans which were offered as a means to bring it about, indicate that the circumstances and conditions under which our merchants engage in business at New York differ very greatly. It is obvious that the merchant occupying loft space in a manufacturing building would have a lesser amount of room within which to store inbound shipments than would a manufacturing concern operating warehouses in connection with its producing activities. The same is true in connection with wholesalers and retailers. Some concerns have larger facilities than others and consequently can conveniently remove from the carriers' terminals and store on

their own premises larger quantities of freight.

"While the advantages of quick transportation would be a very material benefit resulting to New York shippers and receivers of freight under an effectively operated store-door delivery system, it must also be admitted that in some instances and under the requirements of some of the plans which have been advocated, there is a decided disadvantage to merchants ordering goods in excess of their receiving capacity at New York. It is believed, however, that the advantages of quick delivery accruing to the majority of the users of freight service at New York are far greater than the disadvantages which might be experienced by some merchants following the practice above stated.

Cost Must Be Reasonable.

"The third great need of our merchants is to secure delivery at a reasonable cost and herein lies most of the objections which have been made to the store-door delivery plans so far formulated.

"What is a reasonable cost for delivery to one man may be quite unreasonable to another, depending upon the type of goods handled and other circumstances and conditions under which the delivery is made. To my mind one of the great drawbacks to the store-door delivery plans heretofore presented has been the apparent lack of option to the merchant of securing the performance of the delivery service in such a manner as is most advantageous to him. However, where the plans do not provide for such optional delivery when they were originally formulated they have by subsequent amendment made such provision.

Consolidation of Trucking Facilities

"Perhaps it is impossible to establish a really effective system of direct delivery without consolidating the existing trucking concerns and equipment into two or three big companies. It seems to me, however, that even though this is done there will always be some concerns whose business requirements, in their own opinions at least, necessitate their ownership and operation of trucking equipment. I think therefore that the plan which is ultimately adopted will provide for the optional delivery to the merchant under such conditions as will not interfere with the operation of the general system.

"At present there are probably 150 to 200 public and private trucking companies handling freight from Manhattan railroad stations and piers. Even during periods of business activity one can walk along West street on the North River, or South street on the East River and see many trucks going to or coming from the freight stations with one, two or three cases for delivery to the carrier or to the consignee. It is true that when such a truck arrives in line at the piers the driver, if he has only one or two cases to deliver, can and often does secure the consent of the truckman preceding him in the line to place the case or cases upon his truck, the preceding truckman undertaking to deliver the goods to the carrier and arrange for delivery of the bills of lading to the truckman originally undertaking to make the delivery. The operation of trucking equipment in this manner, is not an economical method to the merchant, and this situation is created through lack of organization and systematic operation of our trucking equipment. Of course there are many concerns doing business here whose output may not exceed one or two cases per day and the shipments of these concerns must be handled. During August of this year the American Railway Express Co. made 2,626,000 calls to pick up outbound shipments from Manhattan, The Bronx, Jersey City and Brooklyn. During this period that carrier made 857,000 calls delivering inbound shipments, or a total of 3,483,000 calls. Of this total 85 per cent of the pick-up and delivery calls was made on Manhattan Island. Seven hundred and eighty-six vehicles were used to perform the service, 412 being engaged in pick-up service for outbound shipments and 376 for deliveries.

Average Number of Calls

"The average calls per vehicle in pick-up service during August were 6,400, or 237 calls per vehicle per day. The average calls per vehicle in delivering inbound shipments were 2,280, or 84.4 calls per vehicle per day.

"While no figures are available showing the number of calls per day of freight vehicles at railroad terminals, it is reasonable to assume that no trucking concern in New York City is making 84 calls per vehicle per day or even 71 calls per vehicle per day on either inbound or outbound shipments.

"Perhaps under the most effective system of store-door delivery which might be devised this record could not be attained, but every one with whom I have conversed agrees that under a properly operated system a higher standard can be reached than exists today.

Conclusion

"In January, 1918, the Directors of The Merchants' Association of New York approved a plan proposed by the Transportation Committee of The Association for relieving the congestion in the Port of New York.

"In March of that year, Hon. James S. Harlan of the Interstate Commerce Commission made a report to the Director General of Railroads at the beginning of which he stated he was confident that store-door delivery will 'afford substantial and prompt relief if put into effect.'

"In December, 1920, the New York Port and Harbor Development Commission recommended to the Governors of New York and New Jersey inauguration of voluntary store-door delivery by an organized motor truck medium.

"The desirability of establishing store-door or direct delivery at New York seems to be conceded by all representative organizations. One prominent member of this Society of Terminal Engineers stated in March of this year that store-door delivery and collection in one form or another, under the operation of natural law which requires the relief of congestion, will soon be brought about. That his prediction was sound is proved by a modified form of store-door delivery which is now effective. May we not reasonably expect that a more general form will soon be established and safer delivery, quicker delivery and delivery at more reasonable cost will soon be secured to the merchants of New York?"

WHY IT PAYS TO BEAUTIFY WATER WORKS GROUNDS

By R. E. McDonnell, of Burns & McDonnell, Consulting Engineers, Interstate Bldg., Kansas City, Mo.

It is almost impossible to over-dress or over-do the beautifying of water works grounds. The first impression of a water plant, like the first impression of an individual, is gained from appearances and may be favorable or unfavorable. The water plant does not exist that can afford to ignore public opinion. Without favorable opinion, it is almost impossible to make 100 per cent collections, difficult to enforce regulations, and useless to attempt the raising of funds for extensions or rehabilitation.

Out of approximately 6,000 water plants in the United States, it is a safe estimate that half of them have no ornamentation or artistic treatment of the grounds and their appearance is such that public opinion is unfavorable concerning the works. About 80 per cent of all water expenditures are for wells, mains, conduits, services, meters, and other underground structures; consequently, the buildings and grounds constitute a relatively small expenditure in comparison with their importance from the standpoint of the visitor. The entire water plant is judged by the appearance of that part visible to the layman.

If the grounds are clean, well kept, artistic, and pleasing to the eye, the whole plant instantly receives favorable approval. The money spent in beautification of the grounds is a wise expenditure and a good advertisement for the entire city, for cities are judged by their water supplies. The health record of a city is an indication of the kind of water supply it has.

The safety and purity of a water supply is often judged by the external appearance of reservoirs and surroundings. A feeling of security of health is assured when buildings and grounds are immaculate in appearance. Even the smallest plant can afford a few flower beds, shrubbery, and perhaps a little pool or fountain. I sometimes think women would make better water officials than men, their artistic temperament is more highly developed and they would at least apply their good house-keeping principles to the grounds and station.

Some cities have either located their stations in city parks, or Park Departments have taken over the grounds as a part of the park system. South Bend, Indiana, has its principal station in Riverside Park and the architecture of the buildings and character of improvements were designed in keeping with the surroundings. The St. Louis water works surroundings are very elaborate, consisting of fountains, pools, shaded paths, and beautiful drives, making it one of the show places of the larger American cities. Rochester, N. Y., has in its water reservoir a fountain that adds to that city's fame and reputation and is long remembered by visitors. Our ancient aqueducts, with their graceful vine-covered arches, were structures of beauty, but with the advent of pumping machinery and pipe lines in their places, we are not seeing as many pleasing water structures as formerly existed.

No one ever questions the wisdom of this expenditure for beautification. It pays for the small town as well as the

large city. It is good advertising and good business for the superintendent, the mayor, the Water Board, and the city and it does the consulting engineer no harm to give to his job an attractive appearance.

The foregoing matter is from a paper by Mr. McDonnell before the annual meeting of the Southwest Water Works Association at Hot Springs, Arkansas, on Sept. 26, 1922.

REDUCING THE INDUSTRIAL POLLUTION OF INDIANA STREAMS

Determined that pollution of public waters in Indiana shall be held down to a minimum in order that public health be protected and safeguarded, the state conservation department has started a campaign against firms and corporations which it is charged continue to discharge refuse matter into streams and rivers with the direct result a tremendous amount of aquatic life has been killed and the health of the citizenship menaced.

The courts are appealed to as a last resort in the campaign for improved conditions, says Richard Lieber, director of conservation in Indiana, and it is gratifying to note that in the hundreds of pollution cases coming to the department's attention each year, only a few necessitate settlement in justice tribunals. Others have been disposed of satisfactorily by the department and the firm or individual co-operating to a common end and to mutual benefit.

Mr. Lieber announces that the Citizens Gas Company of Indianapolis, charged with polluting Fall Creek because of a contaminating discharge of tar emulsion from the company's Langsdale avenue plant, has been convicted in the Indianapolis City Court. The company appealed the case. Other suits filed to date are against the Princeton Canning Company for pollution of Big Lick Creek at Brownstown; Snider Preserve Company, of North Vernon for polluting the Muscatatuck river; the Swine Breeders' Pure Serum Company of Thorntown for pollution of Sugar Creek; the Paper Board Company and the Ft. Wayne Corrugated Paper Company for pollution of the Mississinewa river at Marion.

Affidavits are prepared and will be filed as soon as the various circuit courts convene in fall session, against firms at Ladoga, Franklin, Zionsville and Pierceton, and it appears at this time that the cleanup campaign of the conservation department will extend to the point of court action against firms at Elwood, Acton, Shelbyville and Sharpsville.

The conservation department through its counsel, will prosecute all pollution cases under the statute making it a criminal offense to kill or injure fish by polluting a public stream. The penalty upon conviction is a fine of not less than $50 and not to exceed $1,000 each day, with court costs. Each day the offense continues constitutes a separate case, the law reads.

Civic interests all over Indiana are awakened over the matter of stream pollution, conservation officials say, and have at last recognized that the time is here when a halt be called on this public nuisance so menacing to the health of the commonwealth. In most cases, it is pointed out, that firms and corporations responsible for stream pollution, have willingly aided and co-operated with the conservation department to remove the menace. For instance last year the Holland-St. Louis Sugar Refining Company of Decatur, at the instigation of the department, improved its plant by installing modern machinery at a cost of $250,000. The result was the company recovered an extra ten tons of sugar each operating day which formerly was discharged in St. Mary's river as pure waste, and which polluted that stream for a distance of 25 miles. In addition the beet rootlets which constituted the source of contamination when they decayed, are now reclaimed at the rate of 30 wagon-loads a day and converted into stock food that brings financial returns to the company. St. Mary's river is also free of pollution from this source, it is pointed out.

In the opinion of conservation officials the public is determined that pollution of public waters cease, and already hundreds of letters to the department lead officials to believe that more drastic legislation will be sought at the next General Assembly.

RECENT DEVELOPMENTS IN SEWAGE TREATMENT

By George W. Fuller, Consulting Engineer, 170 Broadway, New York, N. Y.

(Editor's Note: The following summary of the more important recent developments in sewage treatment was made

by Mr. Fuller in his address before the annual convention of the American Society for Municipal Improvements held at Cleveland, Ohio, Oct. 2-5, 1922. The discussion is so interesting, and so authoritative, that we feel impelled to publish it all in this issue.

The purpose of this paper is to outline briefly some of the recent developments in this important field of municipal improvements, partly to indicate the trend of progress within the range of the writer's observations and partly to facilitate discussion on the tendencies now revealed as to the selection of types of plants for projected installations. A review of observations and experiences in a field as great as this can at best hit only a few of the high places and no attempt will be made to deal with technical details.

Skimming Tanks

At Toledo a pumping station is about completed which will deliver sewage from the intercepting sewer system into a "skimming tank," prior to dispersion of the partly clarified sewage through submerged multiple outlets, 10 in number, near the channel of the Maumee river and about 550 ft. from shore.

This skimming tank receives the sewage after it has passed through cage screens with a double set of bars having about 0.3-in. openings in the direction of flow; and in it the sewage will rise to a sufficient elevation to provide head for its discharge through the outfall pipes. The sewage in the tank has a circulatory movement due to the arrangement of the inlet and outlet. This causes an eddying effect so that the floating materials will rise to the surface, allowing grease to become attached to match stems, corks and other solid matters which will be removed from time to time by skimming the surface.

This device is closely similar to the skimming tank at Washington, D. C., which is described in the author's book on Sewage Disposal, page 405, and which has attracted much favorable comment because of the elimination of floating matters of sewage origin from the vicinity of the submerged outlets in the Potomac river.

The skimming tank at Toledo is arranged so that its performance may be supplemented at some future date by fine screens.

Fine Screening

Usefulness.—The usefulness of fine screening is indicated by its recommendation or adoption at a number of important projects for ocean outfalls and sewers discharging into tidal estuaries. Its adoption has been recommended at Los Angeles, Cal., and its use along the water front of New York City still continues, as shown by recent lettings for fine screens for sewers discharging into New York Harbor.

Probably the largest fine screenings projects now under consideration relate to use in connection with the activated sludge process at Milwaukee, Indianapolis and Chicago, where it is believed that the removal of the coarser sewage matters will improve practical operating conditions and effect economies amounting to more than the cost of fine screening.

Fine screens are also very helpful in many cases in removing sewage solids, to prevent clogging of nozzles of trickling filters, either in connection with or independent of preliminary sedimentation.

Types.—Recent developments in mechanically operated screens show that manufacturers are giving much attention to this type of device. The Riensch-Wurl screen, such as adopted for Bridgeport and described by Mr. McElroy in the 1920 Proceedings of the Society has found competition from cheaper types, such as the Dorr screen installed at New Britain, Conn., and Bethlehem, Pa., the Link-Belt Co. screen at Pleasantville, N. J., and the Rex screen as developed at Milwaukee by the Chain Belt Co. At Indianapolis, Mr. Hurd has designed a drum screen which is being built by the Chain Belt Co. at Milwaukee. To what extent cheaper types of screens will pass through experiences calling for heavier construction to make them durable, as was the case with the Riensch-Wurl screen following its extensive use in Europe, remains to be seen and need not be discussed here.

Disposal of Screenings.—Probably the simplest way of disposing of screenings is to turn them over to the local garbage and refuse department. This is done at the Dyckman Street plant in New York City and the screenings are barged to sea. Screenings may also be sent to a dump and covered promptly and adequately with earth so that they will not produce a nuisance. At Rochester it is understood that the covering is made with material removed from the grit chamber and that the quantity of this material is not always sufficient. At New Britain the screenings are lifted from the chamber, in which a Dorr screen is placed, by a bucket elevator with perforated buckets so as to

remove free water. The screenings are taken to a dump at an isolated site. Such dumps, if not covered with earth, may or may not give trouble from odors or flies. At Washington, Pa., the screenings are removed from the dump only once or twice a year just prior to spring and fall plowing, and not always completely on these occasions. The screenings from the plant are removed by a wheelbarrow on a runway arranged so as to permit, when necessary, of an adequate application of chloride of lime.

Fine screenings accumulate at the rate of 12 to 15 cu. ft. per 1,000,000 gals. of domestic sewage and in many cases are applied directly to land. This is done at Plainfield, N. J., day by day, where the screenings discharge directly into a manure-spreader from which they are applied to land and plowed in at frequent intervals during the warm season of the year.

Burning of screenings was practiced for some time in an oil-fed incinerator at Long Beach, Cal., but this whole plant, while seemingly working well at first, has been greatly overtaxed so that helpful data are not now available.

At Indianapolis Mr. Hurd proposes to mix the screenings with the settled sludge from the sedimentation tank of the activated sludge process and dewater the mixture.

Imhoff or Two-Story Tanks

Generally speaking the flowing-through compartments are made somewhat smaller than was the practice some 10 years ago, whereas all sludge storage and handling arrangements are made substantially larger than formerly. Even under these conditions two-story tanks while found to be efficient clarifying arrangements are not free from complications as to incomplete sludge digestion, foaming at gas vents, accumulations of floating sludge, and the release intermittently of large quantities of gas, so that on some occasions odors are transmitted for considerable distances.

Upper Compartment.—The flowing-through compartment is now ordinarily built of a length of about 70 to 90 ft. Longer tanks are scarcely worth while because there is very little increase in clarification after the sewage has traveled from 30 to 50 ft. from the inlet. Thus with the shorter tanks, upon reversing the flow, the sludge is quite well distributed in the digestion chambers. Linear velocities should not exceed about 1.5 to 2 ft. per minute under ordinary conditions. Velocities in excess of 2.5 ft. per minute show a falling off in the removal of suspended matters. Detention periods earlier figured at two to three hours may well be cut in two for average flows, without affecting the degree of removal of suspended solids.

Vents.—These should occupy about 20 per cent of the total area of the tanks. Smaller vents are liable to give trouble through insufficient provision for handling floating matters and through irregular release of gases. On the other hand, much larger vents and extensions of the vents for several feet above the flow line in the tanks do not entirely stop foaming over into the flowing-through compartment or irregular release of gases.

Lower Compartment.—The percentage of water in the deposited sludge is apt to be very much higher than was formerly anticipated. It is not safe to figure on less than 90 per cent and in the case of tanks at Plainfield, N. J., and York, Pa., dealing with the flow of separate sewers, the water content has frequently been found to range from 93 to 96 and average about 94 per cent. This means that the sludge chambers should be much larger than originally figured when based on about 85 per cent water content.

In the northern states where sludge is not removed during the severe winter season the sludge storage on a per capita basis should range from 1.7 to 2 cu. ft. per capita. Even this does not provide from more than about six months' storage of the sludge on an average, as against a nine months' storage period which may be desirable for some localities. On the other hand, in southern climates where sludge may be removed frequently during the winter months the sludge storage may be made somewhat smaller.

In recent instructions, issued by the Minnesota State Board of Health, it is specified that the sludge capacity shall be at least 2 cu. ft. per capita, with a plant handling sanitary sewage; and 50 per cent more than this for tanks handling the flow from combined sewers. It is furthermore stated that this capicity should be figured from a plane 2 ft. below the slots and above a surface at an angle 30 degs. from the horizontal and beginning at a point 8 ins. below and directly under the lower edge of the sludge removal pipe.

A recent design for Fort Worth, Texas, provides for 1.21 cu. ft. per capita of sludge-storage space which is considered sufficient with sanitary sewers for the

climatic conditions there prevailing.

Tank Covers.—For control of odors buildings over Imhoff tanks have often been considered, although, with perhaps the exception of a plant at Austin, Texas, none have been built.

Reversed Flow.—At Huntington, L. I., where the effluent from Imhoff tanks discharges into the harbor, the plant operator has changed the connections at the ends of the tanks so that the sewage may enter the gas vents at a velocity sufficient to move along for a considerable distance from the inlet end. Then the sewage moving downward is mixed with the contents of the digestion chamber, with its contents of black sticky sulphide of iron, and rises up through the slots and thence out through the outlet end of the flowing-through compartment. Within certain limits it is believed that this arrangement brings about additional clarification through the coagulating effect of the gelatinous iron sulphide.

Sludge Beds.—The original provision of 0.33 sq. ft. per capita for area of sludge beds has been found to be much too small in northern climates, where little or no use may be made of the beds for 3 or 4 months during the colder season of the year and where frequent rainfall interferes with drying during the warmer months. In the northeastern states the writer has found it advisable to provide 0.75 sq. ft. per capita for plants dealing with sanitary sewage. In the case of combined sewers the sludge beds ought to be at least 1 sq. ft. per capita. The latter limit is called for by the Missouri State Board of Health.

Separate Sludge Digestion Tanks

Experience in this country with digestion of sewage sludge removed from sedimentation tanks to independent tanks devoted exclusively to the digestion of the sludge is somewhat limited.

Extensive use, however, has been made of separate sludge digestion tanks at Baltimore in connection with hydrolytic or single-story sedimentation tanks in which the sludge is more or less digested prior to removal. In 1914 these separate sludge digestion tanks consisted of 3 square tanks and 16 circular tanks with a combined volume of 939,000 cu. ft. At that date the average sewage flow was approximately 23,000,000 gals. daily of an average strength approximating 100 gals. per capita. For a time these tanks worked well as regards sludge digestion but gradually became overtaxed during the war period. By 1920 the average daily flow was more than 52,000,000 gals. and the construction of more digestion tanks was undertaken. When adequate tankage is available, it is stated by the Baltimore operators that the sludge digests well in separate tanks, but if the tankage is relatively small some of the sludge may reach the outlet in an undigested condition.

Single-Story Tanks Used in Rotation

About a dozen years ago an effort was made with the old single-story septic tanks at Plainfield, N. J., to operate the tanks in rotation. The sewage was allowed to flow through one tank until the effluent contained objectionable quantities of suspended matter. Then this tank was put out of service and a second tank was placed in service until it also showed gas-lifted solids in the effluent. In this way three tanks were devoted to sludge digestion while one was receiving the sewage flow for sedimentation. The plant became overtaxed and did not serve the purpose satisfactorily although there were substantial advantages in this style of operation as compared with the use of the tanks in parallel. The plants at Morristown, N. J., and at Washington, Pa., since their early days, have been operated in this manner and until the plants were overtaxed satisfactory results were obtained. Within certain limits these arrangements allow a separate digestion of sludge and of scum in the tanks where there is sufficient sewage to dilute the toxic products of decomposition, and if a tank is allowed to digest, as is the case in the lower compartment of two-story tanks, it is feasible to remove the sludge in a well digested condition.

Another advantage of this process is that it provides for tanks of a depth of not over 10 ft.; preferably covered with a tight concrete cover, an important factor in preventing a dissemination of odors.

The removal of the digested sludge is not so convenient as with two-story tanks since it requires special labor and flushing from a hose, and also handling considerable septicized sewage found in the tank above the digested sludge.

This type of tanks should be built in 5 or more compartments with a total capacity of 18 to 24 hours of average daily sewage flow. They are much cheaper to install than tanks of the two-story type, especially where quicksand or rock is encountered.

This is the type of tank recommended shortly before the armistice for adop-

tion for army camps. Limited funds among other reasons resulted in its recommendation recently for a large state hospital at Morris Plains, N. J., and also at El Paso, Texas, it is understood, because of quicksand at the most suitable available site.

Plain Sedimentation With Continuous Sludge Removal

At Syracuse, N. Y., extensive tests have been made with sedimentation tanks arranged with scrapers working along the bottom of the tanks from the outlet toward the inlet end. It was found that the velocities should not exceed about 1.75 ft. per minute and that the detention period need not be more than about three-quarters of an hour. Thus at Syracuse about 60 per cent of the suspended matter was removed, with comparatively little improvement resulting from a longer detention period or a lower velocity. Continuous removal of the sludge prevents the formation of gas and of gas-lifted floating sludge. Floating matters are retained by scum boards. Solids removed from the floor of the tank by the scrapers will be mixed with wastes from the Solvay Process Company.

At Indianapolis "concentrate thickener tanks" have been designed, 4 in number, 15 ft. wide at the top and about 120 ft. long. The floors of these tanks will be scraped by moving scrapers from the outlet toward the inlet end at a speed not to exceed 5 ft. per minute. These tanks will receive the solids rejected by the screens, and their effluent may be sent to the river or pumped to the influent of the aerating tanks of the activated sludge process. The sludge from the thickener tanks will be mixed with the settled sludge coming from the activated sludge process and the resulting mixture dewatered.

Contact Beds

Under ordinary conditions contact beds are not as economical as regards total cost as are trickling filters. However, for some institutional and small city plants, they have a distinct field of usefulness. For large institutions and residential towns they afford the advantage of not calling for as great isolation as trickling filters, in that they do not expose the sewage to view until after it has been rendered non-putrescible in beds to which clarified sewage is applied beneath the surface. Furthermore, the filling of the voids in the stone prevents trouble from flies.

In Ohio, where the tax laws make it important as will be explained beyond, to minimize operating expenses it has been found that in some instances the smaller head required for contact beds justifies the greater investment through the elimination of the need for pumping with its attendant operating costs. Con tact beds have been adopted at Marion and other places in Ohio.

In securing a non-putrescible effluent it apparently makes very little difference whether single or double contact beds are used as the loading per cubic foot of material seems to be the controlling factor. Where the effluent is to be discharged into a fairly small stream above the intake of a water supply there is considerable merit in using contact beds followed by sand beds as is done in numerous cases in New Jersey. If the stone in the contact bed is of a relatively large size it is prudent to provide a settling basin between the contact bed and the sand bed.

Trickling Filters

There are dozens of trickling filters which have been in successful service from 10 to 25 years in this country and England. Taken as a whole they have been as successful as, if not more so, in producing practical accomplishments, in line with what was earlier expected of them, than any single group of treament devices in existence. Twenty to 25 years' use has not caused need for cleaning English filters and records of a similar nature are available in this country with plants that have been in service a dozen or more years.

Aside from the general commendation as to their performance, trickling filters are worthy of note here in relation to three factors that are frequently discussed by sanitary engineers. They relate to the question of odor, plant loadings and control of flies which may be objectionable in the neighborhood.

Odor Control.—Trickling filters will not produce objectionable odors, noticeable more than one to three hundred feet away, if they receive sewage which is not partially decomposed or septicized. "Nozzle odors" are to be found at some plants where decomposing sewage reaches them through septic tanks or, in some extreme cases, where the sewage is in a stale and putrefying condition before it reaches the preliminary tanks. Bothersome conditions arise from foaming tanks, of the two story type, particularly when the tank effluent contains decomposed matters in substantial quantities either from

overflowing gas vents or from the entrance of material from the lower into the upper compartment.

In connection with nozzle clogging it is to be pointed out that even where tanks are used, the use of screens to retain floating matter is sometimes highly desirable, as is evidenced at Baltimore and elsewhere. Furthermore, complete freedom from nozzle clogging is not possible, owing to the intermittent detachment of the accumulations of fine suspended particles which adhere to the inside of the influent distribution system to which the nozzles are attached.

Experience at Brockton, Mass, for some four or five years shows that nozzle clogging can be kept in reasonable control by the continuous use of fine screens. Similar results are recorded by Mr. Hammond at Brooklyn, N. Y., in his experience when operating for some months trickling filters receiving screened sewage.

Filter Loadings.—Behavior of trickling filters in practice shows that for the ordinary 6 ft. bed a two-million-gallon rate per acre is by no means excessive. This equals 3333 persons per acre foot with sewage of fairly normal strength, say 100 gals. per capita daily. Special tests made at Schenectady and experiences at some other plants where filters were overloaded indicate that a non-putrescible effluent may be obtained with rates in excess of these, say up to 4,000 persons per acre foot. This is particularly true if the beds are made somewhat deeper than usual so as to guard against passage of some of the influent too quickly from top to bottom, and further providing that the spacing of the nozzles and the head upon the nozzles is such as to secure a distribution of sewage over the surface of the bed as uniform as practicable, and more uniform than is found at quite a number of plants now in operation.

In northern climates there is some falling off in nitrification of the effluent during winter months, although this seldom cuts much figure as regards objectionable conditions in the body of the water into which the effluent after sedimentation is discharged. In southern climates on the other hand it is feasible to use filter loadings substantially greater than in the north and equal in some cases to fully 5,000 persons per acre foot.

Filter Loadings with Unsettled Influent.—The loadings above mentioned relate to sewage that is passed through sedimentation tanks. When the latter are omitted and the sewage passed through fine screens the removal of suspended and organic matters is much less and it is necessary to consider carefully what the adjustment in loading should be.

First it should be recalled that nozzle clogging is not a point at issue in this connection. Secondly, it should be recalled that screened sewage from the ordinary American city contains no more suspended matter than does the settled sewage of many European cities, or of some American cities in the southwest where 100 per cent meterage and other factors minimizing water consumption reduce the flow of sewage to from 60 to 75 gals. per capita daily.

There are two aspects to this filter-loading problem in reference to adjustment between requirements for settled as contrasted with a fine screened influent. One factor is the suspended matter and the other is the organic matter. Tanks usually remove from 50 to 60 per cent more suspended matter than do fine screens and perhaps as much as 30 per cent of the total organic matter.

A further element to be considered is the result of experience accumulated in England by the Royal Commission as a result of its investigations for more than a dozen years. Their investigations are summed up on page 65, Appendix IV, Fifth Report, 1910, with the conclusion, expressed in American terms, as follows:

> This experiment, therefore, supplements experiments I and II in showing that a trickling filter of coarse material 6 ft. deep can treat a septic effluent of more than average strength and containing about 200 parts per million of suspended matter at a rate of 150 U. S. gals. per cu. yd. per 24 hours, or an effluent of half that strength with 100 parts per million of suspended matter at the rate of 300 U. S. gals., giving in both cases practically the same purification of organic matter and producing a good well oxidized effluent (apart from suspended solids).

Taking the strength of sewage as 150 parts per million, it is seen that this would allow, according to the Royal Commission findings, a rate of 200 U. S. gals. per cu. yd., equal to 3,250 persons per acre foot with an ordinary sewage flow of 100 gals. per capita daily or equal to a loading of 26,000 persons per acre for an 8-ft. bed.

At Lima, Ohio, with combined sewers, a recent design for trickling filters, preceded by fine screens alone, provided 3.6 acres of trickling filters 8 ft. deep to treat an estimated average daily sewage flow of 6,000,000 gals. from a population of 60,000 people. This is equal to a loading

of about 200,000 gals. or 2,000 persons per acre foot.

The suspended matter in the screened influent at Lima is estimated at 175 parts per million, which at the Royal Commission rating would permit a loading of 275,000 gals. or 2,750 persons per acre foot.

Fly Control.—On the surface and in the upper layers of trickling filters there is sometimes, but not always, found a small fly which accumulates at intervals in enormous numbers and which may be windblown for some distances from the filters so as to prove an annoying feature if not controlled. Dr. Thomas J. Headlee, State Entomologist of New Jersey, investigated this question at the Plainfield plant with the results as stated in the Journal of Economic Entomology, February, 1919, page 35. He found these filter flies to be principally "Pscyhoda Alternata" which grow in the films surrounding the filter stone. His investigations showed that the larvae and pupae breathe atmospheric air and if deprived of it for 24 hours they are destroyed. Flooding the filters at intervals of 10 days eliminates the fly growth because it takes two weeks for the flies to reach the adult stage. It is not possible, however, to eliminate thus the development of eggs which apparently will resist the effects of submergence.

By making trickling filters in compartments which can be flooded in rotation for 24 hours once in 10 days it is possible to keep the fly situation under control and to do so without materially disturbing the biological efficiency of the filter bed.

In all recent designs the writer has provided for this feature of submergence although at many trickling filters flies have not proved bothersome.

Activated Sludge Process

It is scarcely necessary to go into much detail as to the nature of this process concerning which many helpful data have been set forth in the Proceedings of this Society through the generosity of Mr. Hatton of Milwaukee; Mr. McVea of Houston and Mr. Hammond of Brooklyn. It is particularly fitting to refer to the operating results from these and other places, not forgetting the city of Cleveland with its extensive tests conducted during 1916-17, and special reference should be made to the Houston data of which an excellent summary appears in Engineering News-Record of July 27, 1922.

Performances.—Operating experiences show that by no means should there be misgiving as to the ability of this process to turn out regularly a clear, non-putrescible affluent from which 90 to 98 per cent of the bacteria in the raw sewage have been eliminated. Whatever may be said as to the practicability of the process relates not to the quality of effluent but to economies of the sludge-handling proposition in particular, and in general to the constructing and operating cost of the process in comparison with tricking filters. Comparative data will naturally vary in different places.

Adoption.—It is worthy of note that within the past year a plant of this type has been put in service at Gastonia, N. C.; the Maywood plant at Chicago is practically complete after long delays in construction; Milwaukee is constructing its aeration and sedimentation tanks; the process has been recommended and designs are being prepared for a plant to serve about 800,000 people in the northern portion of the Chicago Sanitary District; and this process has also been recommended for adoption for portions of the sewage flow of Los Angeles. Smaller plants are also being designed and built at a number of places.

Sludge Handling

This problem furnishes a live topic for discussion with experiences varying from time to time depending upon the state of the art as developed through various devices. The problem obviously is not now in the same light as it was during the war on account of the subsequent drop in the fertilizer market and the inability at the present time to dispose of dry sludge under any ordinary conditions at a figure approaching the cost of dewatering.

Hence, if the advantages of this process as regards freedom from odor and ability to produce a satisfactory effluent are to be availed of, it must, for the present, be adopted in connection with methods which will minimize the cost of sludge handling until such time as the market value of the dry sludge will equal the cost of dewatering. Of course there are exceptions to this rule where some of the simpler methods of sludge removal are not applicable and where at least partial drying is necessary.

There are even cases where the local demand for fertilizer may make it worth while to take unusual steps for delivery of either wet or dry sludge to the farmers in the general locality.

Lagoons.—To one who has not visited the Houston plants it is remarkable that activated sludge can be delivered from

settling tanks into lagoons and there allowed to accumulate year after year without producing nuisance. And yet that is a fact as recorded by the city officials of Houston and by every engineer so far as the writer knows who has ever visited Houston.

For the North Side problem in Chicago a Board of Engineers consisting of Messrs. Eddy, Hatton and the writer recommended the adoption of the activated sludge process, with a delivery of the wet sludge through a pipe line to the waste lands between the Des Plaines River levee and the main drainage channel. The sludge is to be lagooned there until such time as the cost of drying operations will not exceed the proceeds to be derived from the sale of sludge as a fertilizer. This is a suitable local solution of a difficult problem for a certain period during which it is expected there will be substantial advancement in the art of sludge handling.

Sludge lagooning is of course not universally applicable and conditions such as exist at Chicago and at the South-Side plant in Houston are by no means to be generally found. At the North-Side plant in Houston difficulty in finding adequate suitable land for a term of years has already led the city to consider carefully various means of sludge dewatering.

Maclachlan Process.—Much promise now attaches to this process which is primarily a conditioning treatment of sludge with sulphur-dioxide fumes which destroys the gelatinous character of the sludge floc leaving a fibrous and somewhat stringy solid mass capable of settling readily. This gassing results in a coagulating effect plus a partial sterilization of the sludge which tends to eliminate odor and decomposition.

It is claimed that the Maclachlan process prepares the sludge so that it may be either dried on sludge beds at the rate of about 1.3 lbs. of dry solids per square foot of bed per 24 hours as at Gastonia, N. C., or it may be passed through a cylindrical inward flow drum screen covered with 60-mesh brass wire cloth revolving about two-thirds submerged in a vat through which the gas-treated sludge is fed continuously. The free water passes through the screen and the sludge builds up a filtering sheet which holds back the finer particles. As the screen emerges from the water this sludge is picked up on a traveling felt belt similar to the "wet machine" used in the paper industry. After being picked up on the belt it is passed through squeezing rollers where some of the water is pressed out and it is then discharged from the belt in a thin sheet with a water content of about 80 per cent. This process has been tested at Houston beginning about the first of July and is said to produce a sludge cake of the water content above mentioned at a cost of from $5 to $7 per ton of dry solids.

Sludge Drying.—The limits of this paper do not permit of a description of the Oliver filter or sludge presses of various types which have been under investigation and which will doubtless receive further attention at Milwaukee and at the Maywood plant in Chicago before final conclusions are drawn.

As regards the drying of the sludge cake to the 10 per cent moisture required by the fertilizer trade, it is sufficient here to say that there is no reason to believe that this problem cannot be kept under reasonable control. Experiences in dealing with other odor-producing substances, however, show that dryers of ample proportions must be used and that adequate arrangements must be availed of constantly for the elimination of odors as well as dust by means of combustion chambers, dust catchers, spray jets and the like.

Fortunately data are now being accumulated at a number of places so that there is reason to believe that there will be opportunity to place activated sludge on the market commercially as soon as the economic conditions warrant.

Final Tanks

In all oxidizing processes other than sand beds there is need of settling the effluent, whether it be obtained from trickling filters, the activated sludge process, or the "direct oxidation" process. There is now a well defined tendency shown in various places to remove the sludge from such settling tanks at fairly frequent intervals, if not continuously, by the aid of Dorr thickeners, which facilitate the delivery of the deposit on the floor of the tank to a sump.

Electrolytic or Direct Oxidation Process

The use of electricity as a purifying agent has appealed and continues to appeal fascinatingly to the lay mind. For more than 30 years arrangements in which use is made of electricity have come up for consideration. The writer first became acquainted with the so-called "Webster process" of this type in London in 1890. In test plants this process was shown to be to a considerable extent a coagulating arrangement whereby elec-

tricity was used to decompose iron or aluminum electrodes, thus forming hydrates of these metals. The effective work was chiefly done in a manner more or less resembling the coagulating effect in water treatment plants in which use is made of sulphates of iron or alumina.

Undoubtedly there is some electrolytic decomposition of water even where iron and aluminum plates are used and bubbles of oxygen and hydrogen are released. Some of the oxygen is released in an atomic or anodic state whereby it has a high power for oxidizing even inert organic matter. Excessive cost has kept this process from general adoption.

Harris Process.—The writer investigated electrolytic arrangements of this sort at Louisville at considerable length in 1897, but they did not offer reasonable prospects for practical success. The arrangements tested at Louisville were known as the "Harris magneto-electric process." Plants of this type were installed for sewage treatment at Santa Monica, Cal., Oklahoma City, and a few other places. But practical accomplishments have been small and all of the plants have been abandoned except the one at Santa Monica which was found a year ago to be still in service under conditions greatly overtaxing its limits of effective performance.

Recent Developments.—During the past 10 years or so much attention has been given to improved arrangements, made largely through the efforts of the Landreth Company of Philadelphia, by the introduction of revolving paddles between the electrodes to remove the gases which cause polarization. Use was made of lime, presumably at the outset to increase conductivity and to lessen the quantity of electricity used per unit area of electrode.

The "Landreth electrolytic process" was installed some 8 years ago at Elmhurst in the Borough of Queens, New York City. It was investigated at length by the city officials of New York, preparatory to deciding whether to adopt the process for other plants within the city limits, but no such plants have been installed.

At Decatur, Ill., extensive investigations were undertaken shortly thereafter, but the process was not adopted and after a delay of some 5 or 6 years trickling filters are now being installed there.

Clark Process.—The "Clark Process" of the electrolytic type was devised and patented by J. M. Clark some 6 or 8 years ago when it received some attention in New Jersey. The successor to this process is known as the "Selo method" which is somewhat similar to the "Landreth electrolytic process" except that in the "Selo method" there is separate treatment of the sludge to which salt is added and there are certain differences in plant details. By this method the sewage is dosed with milk of lime in an agitating tank, then settled in a circular tank having a Dorr thickener and passed through an electrolyzer. The sludge is mixed with a solution of salt and electrolyzed, disinfected and deodorized by the sodium hypochlorite which is formed by the use of electricity. It is claimed that the sludge is rendered drainable to 60 per cent moisture in 48 hours so that it may be used as a fertilizer.

A plant of the "Selo method" was installed several years ago by the Thermoid Rubber Co. at Trenton, N. J. It is understood that the electrolytic features of this plant added little or nothing to the quality of sewage effluent and it was found on a recent visit there that the electrolyzers had been removed.

Direct Oxidation Process.—The Landreth patents covering the so-called "Direct oxidation process" have been controlled by the Municipal Sewage Disposal Co. of Philadelphia, which has installed two plants, one at Phillipsburg, N. J., and another at Allentown, Pa. At Phillipsburg the plant has been in service for about 2 years and last spring an extensive set of tests was made by the State Department of Health but the results have not yet been made public. At Allentown a 3,000,000-gal. plant at a cost of about $180,000 was installed and has been in intermittent service for nearly a year. Sanitary sewers in Allentown have been built only to a limited extent and it is understood that at present there are only about 700 sewer connections which produce a volume of flow which permits the treatment plant to be operated only a few hours each day.

At Easton, Pa., a test plant was installed in 1919 for demonstrating the practicability of the improved devices of Mr. Landreth, in which use is made of both electricity and lime, followed by sedimentation. This test plant was studied by several engineers and chemists of Philadelphia with results as stated in a paper presented to the Franklin Institute in 1919. The Easton plant was also investigated by the Pennsylvania State Department of Health with results as summar-

ized in Engineering News-Record of September, 1919, page 569.

As the "Direct oxidation process" now stands, it may be fairly stated that it has received widespread attention and that the merits of the process have come into sharp controversy. This means that adequate data for giving the process a true rating are seemingly lacking, at least to the extent of being persuasive to the minds of many. Briefly, the opponents claim this process to be no more efficient than if lime alone is used; that the process is unreasonably expensive to operate, especially where the sewage contains a very high amount of hardness requiring a large dose of lime; that the effluent, while very well clarified due to coagulating effect of magnesium hydrate, is not purified of its organic matter to a degree sufficient to serve the local requirements at many places; and that the destruction of bacteria by the process is not due to the action of electricity but on the contrary to the excess of caustic lime in the effluent which ranges from 30 to 80 parts per million.

On the other hand, the proponents of the "Direct oxidation process" claim that it is cheaper to install than plants of the biological type; that it permits an attractive looking and inoffensive plant to be located within built-up portions of the city; and that it allows the sludge to be handled in an inoffensive condition and dried so as to produce a product that is marketable.

It is not the purpose of this paper to go into great technical detail but rather to outline some of the main comparative features of the so-called "Direct oxidation process" and of so-called "Biological processes" as they have come into competition at Lima, Ohio. Controversial aspects of the local sewage problem as it now stands at Lima have produced a deadlock for the present year, leading to a series of claims and counter claims which are of some interest and perhaps of value as a warning guide.

Sewage Treatment Situation at Lima, Ohio

Lima is a city of about 45,000 population with several large manufacturing plants and a growing population outside the present city limits. It is located on the Ottawa river, having a drainage area of about 100 square miles. The flow of this stream, which passes through the heart of the city, becomes almost nominal during summer and is lessened by storage reservoirs above the city into which water is pumped from the river during periods when there is a substantial flow. The result is that the stream bed is practically an open sewer from which offensive odors emanate for a distance of several hundred yards on either side.

Due to the complaints of riparian owners below, the State Department of Health under the terms of the Bense Act ordered the city to purify its sewage. Fuller & McClintock made a report in 1916 on relief sewers, intercepting sewers and treatment works, recommending the adoption of the activated sludge method. But little was done during the war period and beginning in 1919 construction work related largely to relief sewers to improve conditions in the built-up part of the city where the original combined sewers proved inadequate.

In 1921, Fuller & McClintock were engaged to design intercepting sewers and treatment works. After considering the problem in detail they recommended the adoption of fine screens followed by trickling filters and final settling tanks equipped with Dorr thickeners. This decision, differing from the preliminary report of 1916, was made partly because of inability, with the activated sludge process, to treat the sludge in a way to yield any proceeds from its sale, but chiefly because under the Ohio law it is highly desirable, if not essential, to keep the operating expenses of sewage treatment plants at a minimum.

Under the terms of the amended Bense Act the interest charges on bond issues required for the construction of sewage treatment works when ordered by the State Department of Health to correct a nuisance, are not required to be paid from the general fund raised by taxation, to which there is a maximum limit of 15 mills per dollar of assessed valuation.

Operating expenses for treatment works on the other hand must be paid out of funds raised by taxation and must be kept within the 10-mill rate unless there is a special election to authorize, by vote of the people, a special tax above this limit; but in any event a limit of 15 mills cannot be exceeded.

Plans and specifications for the fine screens and trickling filters were completed and approved by the State Department of Health, subject to the provision that preliminary sedimentation would be required if found necessary. A letting was authorized with bids to be received on April 1, 1922. About a week prior to this date, the Municipal Disposal Co. of Philadelphia persuaded the City Commis-

sion at Lima to postpone the date of the letting and to take steps towards receiving alternate bids for a plant of the Landreth "direct oxidation" type. Plans and specifications for the latter were prepared and submitted to the State Health Department for approval. Specific data on the cost, method and adequacy of performance of the "Direct oxidation process" have been requested of the city officials by the State Department, and Col. George A. Johnson has been retained by the city to obtain information in respect thereto.

Several months have elapsed during which the merits and demerits of the trickling filter method (Contract A) and of the "Direct oxidation process" (Contract A-II) have been debated pro and con by the various parties in interest. Briefly, the situation may be summed up as follows:

1. The installation cost of pumping station and treatment works by the trickling filter method, with its established record of adequacy and successful performance for a quarter of a century, was estimated in December, 1921, at $691,000 as compared with a sum said to be about $400,000 for the proprietary arrangement with a number of novel features not yet worked out on a practical scale in a sizable plant.

2. The annual operating cost of the trickling filter method, including all pumping, fine-screen operation and sludge disposal from final settling tank, is estimated to range from $13,000 to $15,000 in comparison with which is an estimated sum of $40,000 for the "Direct oxidation" process. In this latter process it will be necessary to use, according to tests at Lima, about 2,800 lbs. of lime per million gallons and about 150 kw.-hr. per million gallons for electrolyzers, in addition to the costs of pumping and screen operation, attendants for pumps, fine screens, electrolyzers, Dorr tanks, and sludge drying plant (3 tons dry basis per million gallons) of the vacuum filter type. These estimates in each case are for fine screens operating at the rate of 4,000,000 gals. daily for 12 months per year and secondary treatment for the 7 warmer months. As the quantity of sewage increases later the financial disadvantage of the "direct oxidation" process will increase.

3. As to quality of effluent, the trickling filter plant will produce an adequately clarified and non-putrescible effluent, suitable for discharge into the Ottawa River. As regards clarification, the "direct oxidation" process, when an adequate dose of lime is applied, will produce the same result. But as to the removal of dissolved organic matter the evidence indicates that the "direct oxidation" process is no more efficient than "excess lime treatment" alone and that dissolved organic matter is not removed with substantial completeness but is simply left undisturbed in a sterile effluent so long as sufficient caustic alkalinity remains.

4. The "excess lime treatment" for sewage is not a novelty but was employed at London more than 30 years ago and was abandoned on account of the secondary putrefying reactions which took place with the organic matter on the bottom and sides of the River Thames.

CUTTING CORN AT CORNERS TO MAKE HIGHWAY TRAFFIC SAFER

Farmers and land-owners of Indiana were appealed to recently by John D. Williams, director of the Indiana State Highway Commission, to cut corn at corners on state roads to help make highway traffic safer.

In cases where a farmer finds it impossible, owing to stress of other work, to do this at once, Mr. Williams says maintenance division crews of the Highway Department will cut the corn for them.

Highway officials estimate there are many hundred places on state roads where tall corn growing close to the right-of-way makes highway travel exceedingly hazardous because it obstructs the view from either approach. Some land-owners have shown consideration to the traveling public by voluntarily planting low-growing crops. Others, cognizant of the danger, and anxious to co-operate in a common cause, have cut the corn and lessened the peril. It is only those who have neglected to care for this important matter that the Highway Commission, through its district engineers and superintendents, will endeavor to have act at once.

In the opinion of state highway engineers safe traffic on sharp turns and curves necessitates at least a 200-ft. sight distance from each approach. If this distance is lengthened, it is better.

Many farmers have written to the commission in the last few months that next spring they will plant only low-growing crops, such as beans, cabbage, tomatoes, turnips, etc., in fence corners, and will co-operate in every possible way to lessen the danger and to facilitate highway traffic.

Construction News and Equipment

HOW THE MOTOR TRUCK HAS CHANGED TRANSPORTATION PROBLEMS

(Editor's Note—Under the title, "Our New Colossus of Roads," a very interesting article was published in The Industrial Digest for Sept. 16, 1922. The article shows how the development of the motor truck has changed transportation problems and how it may alter the industrial map of the future. It is such a valuable summary that we reproduce it here.)

If you want to get a vivid impression of the size and importance of the automotive industry, stand by the side of the Boston Post Road, which connects New York City with Boston and way cities, and watch the motor traffic. Silent passenger cars will speed past in a constant procession, so fast and so many that you will grow dizzy if you try to watch them closely. Heavy motor trucks will be interspersed among them, carried in the stream like logs in a river. Men, women and commodities—apples, brick, plaster, iron, wire, lumber, oil, poultry, silks, trunks and vegetables—will roll before you, drawn by humming gasoline engines to places where there is need for them.

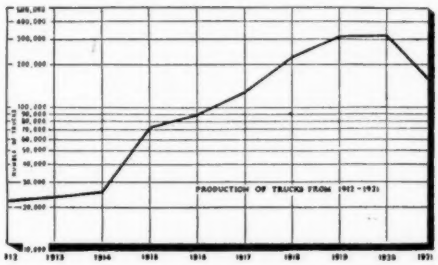
Behind this and similar scenes on roads all over the country, is the automotive industry of the United States, which has grown great by supplying the vehicles needed for road transportation. Nearly $1,500,000,000 is invested in the 407 factories which make motor cars and trucks. Their products are distributed and kept in condition by 78,739 dealers, repairmen and garage owners.

Right now, when the weaknesses of our railroad system are being made conspicuous by a prolonged strike and the prospect of congestion, it is timely to take stock of the situation in motor transportation, the only other practical means of carrying goods and persons overland about the country. What is the place of the motor vehicle in our transportation system? To what extent can motor transportation supplement locomotive haulage? What is the condition of the industry which supplies motor transportation?

* * *

The place of the automobile in the business of passenger transportation is quite obvious. It is thoroughly established as the best possible vehicle for the short trips which are a part of daily life. One significant observation is to be made on this subject: Automobiles are no longer called "pleasure cars" as often as they used to be. Passenger automobiles are used by professional men to carry them to their clients and patients; by housewives to do marketing; by business men for a hundred purposes. In the past few years they have ceased to be toys of the rich, and have become parts of the commonplace life of the country.

The development of the passenger automobile—especially the cheap car—is having an important effect on the real estate market. It is making possible the growth of suburbs further away from cities, and further away from railroads, than has formerly been considered possible. Roger W. Babson is greatly impressed with the



DIAGRAM, FROM AUTOMOTIVE INDUSTRIES, SHOWING PRODUCTION OF MOTOR TRUCKS IN THE UNITED STATES SINCE 1912.

importance of this. He has advised the subscribers to his statistical service to invest in suburban real estate now, simply because automobiles are plentiful. People, including workingmen, are getting tired of paying high city rents, he points out, and if they can invest in a cheap country house and a cheap car to carry them to work or to the railroad they will not stay in the congested districts.

From the viewpoint of industry in general, however, the passengar car is not nearly as important as the truck. Truck manufacturers now look forward to doing

a bigger business than they have ever done before. The use of trucks is growing in all fields.

A Sane View of Motor Truck Transport

There has been much loose talk about the possibility of the motor truck supplanting the railroad. Some enthusiastic persons give the impression that they think motor trucks could haul all the passengers and freight of the country. Of course that is nonsense. For long hauls the railroads are supreme, and probably will continue so, even if they fall into far worse condition than they are in at present. But for short hauls the motor truck is important. Even when the railroads are running well, it is often cheaper to ship by truck for a short distance.

The motor bus is a form of truck used for passenger traffic for which a great future is predicted. Busses are used for rapid transit in 108 cities, and the list is growing. In many cases they are competitors of electric street railways, which many persons (including the mayor of New York City) think they will supplant. But they are more important as feeders for such railways. Recognizing this, no less than 26 electric roads have established bus lines which they operate themselves, as feeders for the cars which they operate over their main routes.

Still other railroads use motor busses with flanged wheels for operation on tracks over short routes. The New Mexico Central R. R. runs a flanged-wheel motor bus line over 116 miles of track, and the New York, New Haven and Hartford operates a 104-mile route. Twenty-five other roads run shorter lines.

The railroad's point of view in this matter is expressed as follows by the Railway Review:

"Light local passenger service is undoubtedly the most expensive luxury, in proportion to the returns, that the railways can offer the public. Whether it be the daily branch line 'turn-around' or the main line 'short-dog' that must be maintained at the mandate of a state commission, it results usually in a very meagre return, while the expense of operation is often considerable.

"This is particularly true where a steam locomotive is used to haul a couple of passenger coaches. Under these circumstances it is seldom that the fuel consumption is less than 400 lbs. of coal per car mile, while a full passenger and engine crew must be employed. Locomotives retained in this class of service are invariably old and decrepit so that the cost of their maintenance usually runs high. Branch lines are seldom built for their passenger traffic possibilities, but once constructed, passenger service is demanded and must be constantly operated even after the original freight prospects may have become exhausted, so that these branch lines frequently transpire into white elephants on the hands of the owning railroads.

"Some years ago large gasoline driven cars entered the market and, subsequently, gasoline and electric cars were substituted for light passenger trains on many railways. Admirable and elegant in construction as these cars proved to be, their first cost in many instances approached that of a new locomotive and the intricacies of their mechanism often demanded a large share of official attention from the chief electrical engineer down. Faced with these discouraging circumstances in the operation of light passenger service, it has been particularly galling to railway management to observe the automobile truck and bus thriving on the very traffic that had caused the railways an actual loss.

"This situation has naturally been aggravated in the minds of railway managers by the fact that the automobile is being run over a road built and maintained by the taxpayers which, of course, includes the railways in large measure. It is as futile, however, to argue against the inroads which the automobile has made upon rail traffic or to suggest the prohibition of this automobile traffic as to remonstrate against the rapid spread of a forest fire.

"The most effective policy is to fight fire with fire. A very plausible remedy is suggested in the form of a rail motor bus. Following closely in detail the main features that are responsible for the successful performance of the automobile truck, it may be assumed a rail bus can be constructed which embodies the same elements of simplicity in construction, reliability in performance, flexibility in operation, light weight and low first cost. It is possible that if the rail motor bus is to be operated successfully as a substitute for the light passenger train in main line service, as well as on branch lines, that a maximum speed of more than 30 miles per hour should be attainable, but it is believed that, if designed to meet various local conditions, the field for a light gasoline rail car patterned after the automobile affords many interesting possibilities in the direction of economy and better service."

Enlightened railroad men see the importance of motor truck transportation, and welcome it instead of fearing it. Elisha Lee, vice-president of the Pennsylvania system, says:

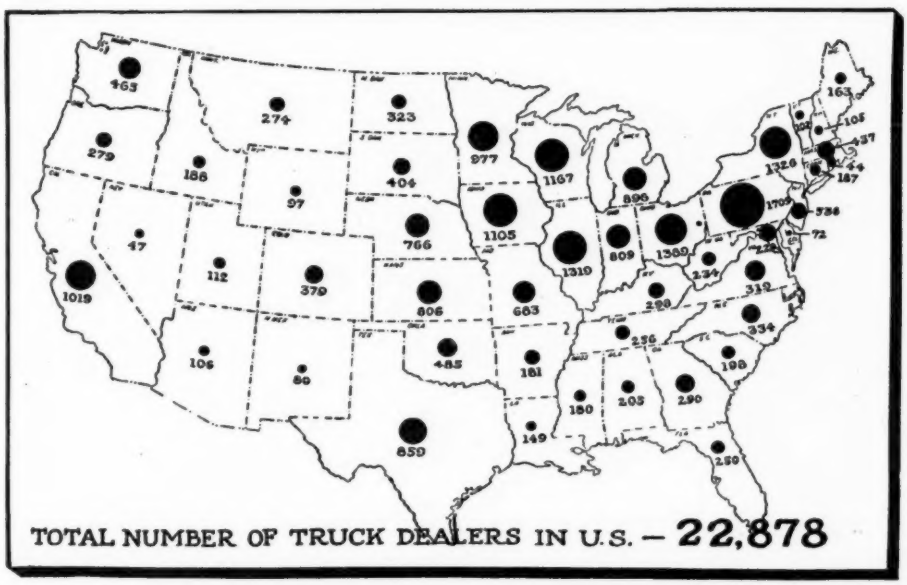
"To the extent to which the motor cars are likely to take over the short haul freight traffic, the railroads will probably be immediately benefited financially, because short-haul business is becoming unremunerative on account of the high proportion of terminal costs which it must sustain. Altogether, I am not afraid of motor cars and aeroplanes making railroads obsolete."

And C. A. Phelan, general manager of the Missouri & North Arkansas R. R., says:

that there are about 1,500 motor express lines in operation now in various parts of the country, of which 984 are listed at the N. A. C. C. offices.

A. J. Brosseau, president of the Mack Truck Co., recently told the Merchants' Association of Greater New York how the motor truck reached its present place in our transportation system, and how it will continue as an aid to the railways:

"It is only within five or six years that the motor truck has been an important element in transportation," he said. "It owes its present important position in transportation to the railroads which were unable to handle the enormous volume of freight traffic moving during the boom of 1917 to 1920.



DIAGRAM, BY CHILTON CO., SHOWING DISTRIBUTION OF TRUCK DEALER ORGANIZATIONS IN THE UNITED STATES. NOTE REMARKABLE CONCENTRATION IN NORTH CENTRAL STATES.

"There is no question but what the motor truck is a great asset in the handling of freight to and from the railroads to the interior country, and there is an opportunity for considerable development along such lines in this country."

This is the picture of the future of truck transportation: a network of lines leading from railway stations and terminals, carrying freight to the roads, and serving interior points which the roads themselves can not reach; plus a great number of short motor express routes carrying goods more economically than the railroads can haul them. The National Automobile Chamber of Commerce estimates

"When the railroads became congested and declared embargoes and were blockaded for weeks at a time, manufacturers were faced with the alternative of shutting down for want of raw materials and supplies, or finding another means of transportation. They turned to the motor truck as a temporary substitute. It served them so well that they have continued to use it since the railroads have succeeded in clearing up the traffic jam after the present business depression developed a year ago. Merchants and farmers were also compelled to use the motor truck to move their merchandise and foodstuffs, and they also have continued to avail

themselves of motor truck transportation over the highways.

"As you all know business has been poor for the last year, and the railroads can now handle all the traffic that offers. We are asked if the railroads are now helped by the motor truck. My answer is 'Yes,' for business is going to be good in the near future, and when it is the railroads will again be unable to handle the traffic. We shall then have delayed shipments, embargoes, blockades, and the truck will again save the situation for the railroads and for the public. It may also save the railroads from the fate they so narrowly escaped during the last traffic jam—permanent government ownership."

Mr. Brousseau quoted W. J. L. Banham, a traffic expert, as follows on the economics of the use of the motor truck:

"Users of motor trucks should consider to what extent they can be operated in co-operation with the railroads for short-haul freight movement. The principles involved are: First, service; second, cost.

"There seems to be no question at the present time that the carrying of less than carload shipments to short-haul points by the rail carriers is not only expensive to the shipper, but is also unprofitable to the carriers. Until recently it seemed to be almost necessary for the shippers to use the rail carriers for the movement of their less than carload shipments to nearby points, regardless of expense and delay, as there did not seem to be any organized effort made by the motor truck operators to take care of this class of freight.

"It is extremely difficult for carriers to figure cost of transportation of package freight hauled short distances and particularly to such points at which they do not have a through car movement. The expense of transferring the less than carload shipments one or more times when moving within 50 miles of the receiving station, and the additional expense caused by the delay of equipment, has been recognized by the Government, with the result that the U. S. Railroad Administratoin during the war ruled that freight destined within a certain radius would not be handled by the rail carriers. It was necessary, therefore, for the shippers to find other means of transporting this class of freight. Motor truck transportation, while still in its infancy at the present time, pointed a way to the shippers whereby their less than carload shipments could be handled not only more promptly, but at a considerable saving both to the shipper and to the receiver of freight alike.

"While it is true that it is almost impossible for the carriers to figure the exact cost of handling short-haul freight, it is equally as difficult for the shippers to ascertain the cost of transporting similar freight. The question of cost brings me to the first part of my subject, and in order to make it clear as to what I mean by costs and what these costs cover, I am going to refer to them as transportation costs. Transportation costs do not necessarily mean less than carload freight rates and motor truck rates, although both rates are a part of the transportation costs.

"What I understand to be a true transportation cost is all expense involved in making a shipment, starting with the boxing, or packing expense, together with handling expense in the shipping department, the loading of freight on teams for delivery to the freight house, teaming charges from the shipping department to the local freight house, and additional labor incidental thereto. To this must be added the less than carload freight rate and additional charge for cartage at the delivery point,with such other expenses that may be caused by requests for tracing, duplication of shipments lost or damaged in transit, entering of claims, checking of freight bills, delay to shipments in transit, and the expense of carrying additional stock to take care of freight in transit when moving via rail carriers.

"All of these costs are properly transportation costs, and are a part of the shipping expenses which are paid either by the shipper or receiver."

In England the railroad companies, less liberal, apparently, than ours, keenly feel the competition of truck transportation, and recently made a drastic attempt to eliminate this opposition. Two important groups of railways, the Northwestern and the Midland, attempted to secure a monopoly of transportation in the areas within which they operate. The trucking interests, after watching the attempts of the railroads to acquire truck lines, decided that the roads intended to stifle competition by cutting rates, thus breaking up the existing highway transport companies and finally diverting traffic back to the railroad lines. They therefore determined to fight the railroads with all their power.

It was necessary under the British law for the railroads to get the permission of Parliament before they could operate as

TABLE I—RAW MATERIALS USED IN CONSTRUCTION OF CARS AND TRUCKS DURING 1921.

(From Accessory and Garage Journal.)

Iron and steel, tons	1,464,000
Production of iron and steel, 1921 (Iron Age)	36,150,000
Per cent. used in manufacturing cars and trucks	4%
Aluminum, pounds	43,250,000
Production of aluminum, 1920 (American Metal Market)	198,000,000
Per cent used in manufacturing cars and trucks	22%
Copper, pounds	83,425,000
Production of copper, 1921 (Survey of Current Business)	510,000,000
Per cent used in manufacturing cars and trucks	16%
Tin, tons	12,510
Total consumption of tin ,1921 (American Metal Market)	60,000
Per cent used in manufacturing cars and trucks	20%
Lead, tons	6,670
Production of lead, 1921 (American Metal Market)	390,000
Per cent used in manufacturing cars and trucks	1.7%
Nickel, pounds	3,400,000
Leather, upholstering, square feet.	37,165,000
Total production of upholstering leather, 1921, estimated by the Tanner's Council at 54,000,000 square feet, but of which only 35,000,000 square feet was suitable for upholstering automobiles.	
Upholstering cloth, yards	5,357,000
Imitation leather, square feet	88,400,000
Lumber used in manufacturing cars and trucks, feet	313,800,000
Glass (mostly plate glass), square feet	16,500,000
Production of plate glass, 1921, approximately	55,000,000
Per cent used in manufacturing cars and trucks	30%
Top and side curtain material, yards	15,330,000
Hair and padding, pounds	16,000,000
Paint and Varnish, gallons	5,900,000

truck owners, except at their own terminals. They already had the right to collect and deliver freight by truck, but not to transport it by highway exclusively. The truck interests, consisting of truck manufacturers, road transport companies and general industrial undertakings employing trucks, combined to bring pressure to bear upon Parliament to refuse the request of the railroads for extension of their franchises. After a struggle the truckmen were successful.

According to Automotive Industries, a similar situation may develop in the United States, especially in California; and the magazine implies that the truck interests in this country ought to form a combination similar to that which was successful in Great Britain, so as to be prepared for all contingencies.

* * *

Observers of the automotive industry believe that this is going to be a record year for trucks. The wholesale value of the truck output in 1921 was $166,082,000; this year it is predicted that production will reach $250,000,000, and that the sale of tires, oil, gasoline, parts, equipment, etc., will bring the total sum spent on trucks up to $1,000,000,000.

Farmers are expected to want more trucks to carry their big crops, for which, it now seems, they will get good prices. The growth in bus transpirtation, which has now got out of the hands of the old rough "jitney" class of operator and into the control of substantial concerns which seek to operate regular lines, will increase the demand. Trucks will be needed to carry coal over comparatively long routes, to help the railroads, whose capacities will be taxed to the limit. It has been computed that coal can be shipped economically by highway over as great a distance as that from Scranton, Pa., in the anthracite section, to New York City, because of the savings effected in loading, unloading and lighterage charges. The coal delivery companies in the cities, who have been idle all summer, will need additional trucks in order to convey the winter's supply to householders.

The 1922 situation in truck production and registration is thus summarized by the Commercial Car Journal:

"Analysis of all existing data indicates conclusively that total sales in the commercial car industry for 1922 will exceed $1,000,000,000, if we total the five principal items: (1) Commercial cars built during 1922; (2) operating supplies; (3) special truck equipment; (4) replacement parts and supplies; (5) service labor.

"About 250,000 commercial cars will be built in 1922. The f. o. b. sales value of these trucks will approximate $250,000,000, or nearly one-quarter of estimated total sales in the motor truck field.

"Gasoline, tires, and lubricating oil are the principal items to be considered under the head of operating supplies.

"Between 1,100,000,000 gals. and 1,200,000,000 gals. of gasoline are annually used for motor truck operation. At an average of 22 cts per gallon, the gasoline bill will total $250,000,000.

"Nearly 5,000,000 tires will be required this year for commercial cars. These will cost approximately $175,000,000.

"About 75,000,000 gals. of lubricating oil at 50 cts per gallon will bring the bill for commercial car lubrication to $37,000,000.

"Sales of truck equipment will consist principally of special bodies, cranes, hoists, winches, cushion wheels, etc. About 200,000 special jobs at an average of $300 apiece will be required this year. Other

truck equipment, costing about $15,000,000, will bring the total of equipment sales up to approximately $75,000,000.

"Replacement parts constitute an increasingly important item of sales in the commercial car field. Sales of such parts in 1922 will total $73,000,000.

"Labor for service and repairs is figured at about $140 per truck per year, which brings the total for over 1,050,000 trucks to about $150,000,000.

"If facts were needed to demonstrate that the commercial car industry is just getting into its business stride, a glance at the growing increases in registration totals for the past few years would dissipate all doubts.

"In 1913 there were 64,000 motor trucks registered. During the period from 1913 to 1921, commercial car registrations have climbed from 64,000 to 1,050,000, an increase of 1,540 per cent. During the same period registrations of passenger cars have increased from 1,159,034 to 9,455,000, or 715 per cent.

"It will be seen, therefore, that the demand for commercial cars has increased at a much faster rate than has the demand for passenger cars, in spite of the fact that the constantly expanding market for automobiles, during the past decade, has been one of the marvels of modern business life.

"Strictly speaking, the commercial car had hardly become a vital factor in industrial life prior to the entry of America into the World War in 1917. The greatest increase in the number of trucks in use has come about during the four-year period since the end of 1917. Hence, a comparison between truck and passenger car business since 1917 brings out the salient facts more clearly.

"Passenger car registrations have increased from 4,805,331 at the end of 1917, to 9,455,000 at the end of 1921, an increase of 96 per cent. During the same period commercial car registrations have grown from 289,000, at the end of 1917, to 1,050,000 at the end of 1921, or 263 per cent.

"If we scan the above figures, we note that during the past four years the number of commercial cars in use has increased nearly three times as fast as is the case with passenger cars, in spite of the fact that during 18 months of this period the country witnessed the worst business depression in a decade."

The automotive industry is at present in a competitive condition which no other industry parallels. The heaviest competition is in the manufacture of passenger cars; but this affects truck production also, for the big concerns in the passenger car business also make trucks, and their truck costs and output are certain to be affected by conditions in the other branch.

The condition of the automotive industry can best be represented graphically by two pillars resting on a single base. The base is the cheap car, made by Henry Ford and a few minor competitors. Rising about it are two parallel piles, representing the car manufacturers in the higher price classes. One pile represents the General Motors Corporation, whose business is built upon the theory of "one car in each class." On the other side are competing manufacturers in each class—Durant, Studebaker and the rest.

Competition between the two sides is terrific. Not long ago a price war was started which, it was expected, would last for a long time, each side successively cutting under the other. The first cuts have been made by General Motors and by its chief competitors; but further slashes have not yet been forthcoming, and the opinion in the trade is that after those manufacturers who are out of line with present prices have made their cuts, the slashing will end for the present.

"The condition of the trade is thus summarized in The Bache Review:

"One of the phenomenal developments in the revival of business which has been proceeding during the present year, is the long leap ahead of output in the automobile industry. Recently, reduction in some motor prices has stimulated sales, but has not greatly reduced earnings, by reason of the larger production. The cut was intended to speed up sales. Not all manufacturers joined in the price reduction, and those who did not, report practically no falling off in their sales.

"July is usually a month of seasonal decline in output, but production this year exceeded that of July, 1921, by 39 per cent, and that of July, 1920, by 20 per cent. This July output constituted the record figure in automobile production for the month of July, but further than that, only two other months (May and June of this year) have, in the history of the industry, shown a greater output.

"This, it seems, is the very antithesis of what might be expected to happen if times were hard. To date, the railroad and coal strikes have had little or no effect upon the automobile business. A long continuation, which is doubtful,

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In the Valley are thriving towns, the largest of which are Mission, McAllen, Mercedes, and Harlingen. Here, too, the broad Tarvia-paved streets give unmistakable evidence of prosperity and sound, substantial growth.

In selecting Tarvia for all their road-building and road-maintenance work, these far-sighted pioneers showed characteristic good judgment. For with no other material could they have converted, at such small expense, their unimproved roads into smooth, dustless, mudless, all-year highways.

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would, however, affect producton—but not the demand.

"In the earlier years when automobile buying was pounding along at a great rate, there were quite a number of wise people who pointed out warningly that at the rate at which automobiles were being bought, there would some time, perhaps soon, come about a situation when the world would be so full of automobiles that no more could be sold. This was confidently predicted. The term 'saturation point' was adopted in automobile literature and has been used for years. It is, however, misleading. Most people take it to mean that period when, having reached the peak of production, cars are being built only to replace those already in use. This, in itself, is also misleading, as we can never reach such a truly balanced condition. There will always be new buyers—that is, buyers who have never before owned a motor car.

"If 'saturation point' means simply the peak of production, it would be a movable point and would last only for a limited period. This is because population and miles of good roads are constantly increasing and more and more automobiles will be used, barring the almost remote possibility of some other method of locomotion being developed that is cheaper and safer, and also barring political and financial disaster.

"It seems reasonable to presume that if the country continues prosperous in a fair degree and this prosperity is well distributed, a minimum average of 2,000,000 cars per year of all kinds can be safely marketed over a period of five years. Then, if conditions remain the same, there ought to be a fair increase from time to time thereafter.

"Statistics show that the population increases on the average about 1,000,000 a year, and out of this increase there will always be a certain number of new buyers. In addition to this, there will always be a number of new buyers among the present population who have not before owned a car.

"Undoubtedly the world will continue to transport itself from point to point on wheels that are motor propelled, and it would be a brave man who would attempt to prophesy the total number of motor cars that can be used in the United States at any one time. But it is not out of the possibilities to believe that in the next 20 years there will be 25,000,000 cars in use in this country alone.

"In the great industrial activity which is taking place, there has been some question whether the high cost of material, and especially of labor, has not made profits in many lines very small or wiped them out altogether. This, however, from the best information we can obtain, has not been the case in the automobile business. Profit, we understand, has not been reduced on account of labor and material costs, as profits in many instances have never been so high per car or per dollar of investment as is the case at present. Many companies bid fair to make more money this year than ever before in their history.

"The prospects for automobiles this fall are estimated to be emphatically good if strikes are settled and there is no injury to crops. As to next year's prospects, it is believed that about the same quantity ought to be produced as this year but at lower prices, and probably with correspondingly lower profits. But even so, it is thought that this will not be an undesirable condition, as many companies made an abnormal profit per car this year and one that they can hardly justify except on the theory that one is entitled to all that one can get."

DON'TS FOR TRUCK DRIVERS

To insure better care of its motor trucks by their drivers, one company operating a fleet of Republic trucks keeps the following list of "Don'ts" posted in a conspicuous place on their loading platform.

Don't try racing with a touring car; your truck was built for strength, not for speed.

Wash your truck frequently; a dirty car can spoil a lot of our advertising.

Street car tracks are nice on springs, but hard on tires and steel costs less than rubber.

Don't neglect a loose part, even though it seems to operate more freely that way.

Don't forget to watch the other fellow ahead; a slow stop on your part nearly always costs you a punctured radiator.

Use your brakes when getting "spotted"; platforms were built to load from not for bumping posts.

Don't drive too close to the curb; edge-trimming is a fine institution for pie crusts, but too expensive for truck tires.

The steering wheel is vastly important, but it is well also to give the grease cups an occasional turn.

Don't slide the rear wheels when stopping; rubber pavement polishers are too much of a luxury.

Contracts Awarded

ROADS AND STREETS.

Ala., Camden—Lawler & Humphries, Ridgeland, S. C. awarded contract by State Hwy. Dept. for 12.5 mi. gravel road on Camden Greenville Hwy. at $151,492.

Ala., Selma—Worthington & Co., Birmingham, awarded contr. for 4.82 miles road, Dallas Co., plain conc., for $139,697.

Ark., Clarendon—J. A. Perdue & Co., Pine Bluff, Ark. awarded contract by Monroe Co. Commrs. Rd. Impvt. Dist. No. 3, for 18¾ mi. gravel rd. bet. Clarendon and Helena, connecting Phillips and Monroe Cos., via Blackton and Marvel, at $212,000.

Ark., El Dorado—V. E. Schvenell Constr. Co., Memphis, Tenn., awarded contract for street paving and storm sewer constr.; 86,331 sq. yds. 6-in. conc. pavement; 55,600 lin. ft. curb. at $250,000.

Ariz., Yuma—R. Twohey, Phoenix, awarded contract for constr., of 43 miles state hwy. bet. Wellton and Maricopa Co. line, at $161, 374.

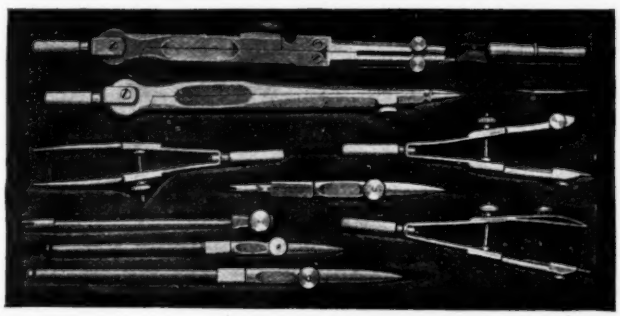
Cal, Los Angeles—Belmont Shore Co., 1015 Marsh-Strong Bldg., awarded contract for constr. of conc. pavement curb, walk, sewer and storm drains on Corona Ave. and other streets near Alamitos Bay, at $116,800, Wm. Liddington, 420 E. 60th St., awarded contr. for paving 1st alley so. of 7th St.—Whittier to Valencia Sts.—at $1,275; W. D. McCray, 416 Am. Nat. Bank Bldg., awarded contract for paving 18th St.—Centro to Patton Sts., San Pedro, at $146,272; Geo. R. Curtis, 2440 E. 26th St., awarded contract for paving Victoria 10th St. to Country Club Dr.—at $23.004.

Cal., Sacramento—Geo. Pollock Co., Sacramento, awarded contract for grading 13.06 miles state hwy. Monterey Co. betw. Anderson Canyon and Sur river, at $786,805.

Cal., Sacramento—W. S. Mead, San Francisco, awarded contr. by St. Hwy. Dept. for 6.8 miles of road to be built in Kern Co., at $281,157; C. B. Christensen, San Francisco, also awarded contr. for 2.7 mi. near Maricopa, at $31,446.

Ga., Lagrange—Davis Constr. Co., Macon, Ga., awarded contr. for 5.5 miles 7-in. plain conc. pavement on Atlanta-Lagrange, Rd., Troup Co., FAP 98, at $132,000.

Ill., Springfield—Following contract awarded on pavement work: Sec. 25, Clark Co. 5.37 mil. to Ralph A. Baum, Paris, Ill., at $116,137; Sec. 164, Cook Co. 1.29 mi. to Chicago Heights Coal Co., Chicago Heights, Ill., at $21,881; Sec. 71, Randolph Co., & Sec. 72, 4.62 mi. to Mautz & Oren, Effingham, Ill. at $95,868 and $102,039, respectively; Secs. 9 & 10 McLean Co., 5.94 & 3.75 miles to R. L. Williams, Wyatt, Mo. at $98,183 and $62,016, respectively; Sec. 19, Sangamon Co., 6.10 mi. to Baker, Agerter & Thompson, Inc., Indianapolis, at $122,-872; S. 12 Lake Co. 4.61 mi. to Darrow & Jacobson, 311 Cory Ave., Waukegan, Ill., at $99,123; S. 17, Kane Co. 0.77 mi. to Jaicks Bros. 275 Thatcher Ave. River Forest, Ill. at $15,694; Sec. 5 & 6, Adams-Brown Cos., to Eiff & Simons, 605 N. 14th St. Quincy, Ill. at $88,529 and $100,560 respectively! S. 1, Jersey Co. 5.36 mi., Nelson Bros. Jerseyville, Ill., at $113,903; Sec. 21 & 22, Logan Co. 4.87 and 5.68 mi. to H. K. Rhoades, Lincoln, Ill. at $88,310 & $100,095 respectively; Sec. 26, Livingston Co.,



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5 mi. to I. D. Lain, Bloomington, Ill. at $106,112; Sects. 36, 37 & 38D, Iroquois Co. 4.23, 6.60 and 2.90 mi. to McMahan Constr. Co., Rochester, Ind., at $91,223, $120,855 and $51,920, respectively; Sects. 15, 16 & 17, Kankakee and Will Cos., 3.65, 5.63 and 4.04 miles to Rieth-Riley Const. Co. Goshen, Ind. at $67,127, $113,906 and $82,266; S. 11, 12 & 13, Washington & Jefferson Cos., 4.17, 3.40 & 5.15 miles to R. L. Williams, Wyatt, Mo., at $70,907, $59,109 & $96,783 respectively; S. 42, Fulton Co. 5.16 mi. to Sutton & Moore, Canton, Ill. at $120,382; Sects. 66 & 67, Woodford-Marshall & LaSalle Cos., to Ind. Road Paving Co., Bement, Ill. at $93,999 and $95,100; Sec. 45, Schuyler Co. 5.21 mi. to Russell Condon Const. Co., 311 Karbach Bldg., Omaha, Neb. at $122,105; Sec. 2, Carroll Co. 5 miles, C. C. Vanderboom & Sons, Pecatonica, Ill. at $110,943; Sec. 2, Christian Co. 6.63 mi. Baker, Argerter & Thompson, Inc., Indianapolis, Ind., at $135,554. Type for all these sections is Portland cement concrete. State Aid Sections: Sec. E, 35 mi. conc. Bond Co. to Stocker Gravel & Const. Co., Highland, Ill. at $8,761; Sec. K-29A, LaSalle Co. conc., to Ill. State Contg. Co. 2,100 S. Wabash Ave., Chicago, at $19,151; S. N-29A gravel, 1.68 mi. Madison Co. Stocker Gravel & Construction Co., Highland, Ill. at $13,432; Grading Sections: Sects. 29A, 30A, 31A, 33A and 34A, White Gallatin, Saline, Williamson and Johnson Cos., 3.70, 5.48, 5.95, 3.12 and 4.36 miles to Louis Rich Const. Co., E. St. Louis, Ill., at $26,592; $15,023, $14,877, $14,834 and $28,953 respect.; Sects. 35A, 36A and 37A, Johnson Co., 4.14 and 5.88 and 4.13 miles to Buis & Olson, St. Joseph, Mo. at $22,776, $29,038 and $25,485 respect; S. 37A & 32A, McDonough & Woodford Co., 6.06 & 2.99 mi. to J. A. McGaughey Co. 1319 Columbia Ave., Chicago, Ill., at 15,821 and $21,932 respect.; S. 37A, 9A and 10A, Tazewell & McLeanl Cos., 1.76, 5.94 & 3.75 mi. to New Era Const. Co., 6448 Bosworth Ave., Chicago, Ill. at $17,891, $19,640 and $12,667; S. 15A Marion Co. 2.76 mi. to W. C. Whitsell, Mt. Vernon, Ill. at $14,209; S. 4A & 5A, Knox & Henry Co., 3.64 & 3.50 mi. to Cameron, Joyce & Co., Keouk, Ia. at $16,950 and $13,342; S. 30A, Logan Co., 0.67 mi. to J. A. McGaughey Co. 1913 Columbia Ave., Chicago, Ill. at $5,881; Sec. 43A, Fulton Co. 2.94 mi. to Buis & Olson, St. Joseph, Mo. at $24,142; Sec. 44A, Schuyler Co., 0.75 mi. A. O. McCoy, Mt. Sterling, Ill. at $27,539.

Ia., Davenport—Central Engrg. Co., City, awarded contracts for impvt. of four roads as follows: Grading and paving Hickory Grove Rd., at $153,098; grading and paving Durant Rd., $155,904; grading and paving New Liberty Rd., $228,279; grading and paving rd. to LeClaire, $144,486; Lehmer Thompson & McDaniel, Wapello, Ia., awarded contract for rough grading on Hickory Grove Rd., at $14,385.

Minn., Two Harbors—A. Guthrie & Co., Inc., 366 Jackson St., St. Paul, awarded contract for road and bridge work at $650,000.

Miss., Charleston—S. K. Jones Constr. Co., Memphis, awarded contr. for constr. of gravel hwy. with asph. surf., from Phillip to Cowart, distance of 19 miles, at $200,000.

Mont., Missoula—Sims & Carlson, Spokane, awarded contract for road work here at $167,000; Sam Boudry, Clarkston, contract for bridge work, Lolo Pass Hwy.

Neb., York—Roberts Constr. Co., 1st Natl. Bank Bldg., Lincoln, awarded contract for 3 miles of paving in Dist. 20; vit. brk. on conc. base at $3.06 per yd. Approx. $170,000.

N. J., Long Branch—Union Paving Co., 30th & Locust Sts., Phila., awarded contract for paving Ocean Ave.,—Sea View to Brighton Aves.—including portions of driveways of intersecting streets or alleys, at $218,000.

N. J., Mt. Holly—Union Paving Co., 30th & Locust Sts., Phila., awarded contract for reconstr. of road bet. Mt. Holly and Medford, conc., at $149,000.

N. J., New Brunswick—Utility Constr. Co., 5 Spring St., awarded contract for paving Albany and French Sts.—Water to Alexander Sts.—$122,644.

N. J., Woodbury—Pub. Service Production Co., 80 Park Pl., Newark, awarded contract for constr. of Route 6, Sec. 14, at $169,776.

N. J., Woodbury—M. Staub, Pitman, awarded contract for paving Paulsboro-Gibbstown Rd., at $92,084; J. F. Burke, 309 Park Ave., Plainfield, awarded contr. for resurfacing Sec. 1, Glassboro-Westville Rd., conc. at J. E. Burke, 309 Park Ave., Plainfield, at $43,497.

N. Y., Buffalo—Rock Asphalt Co., Morgan Bldg., awarded contr. for paving and repaving Delaware Ave.—the Terrace to Mohawk St.—asphalt, at $45,-093; also contr. to same contractor for repaving Hamburg Turnpike from Buffalo Crk. R. R. viaduct to so. city line; sandst. blk. on 8-in. conc., at $175,000.

N. Y., Glens Falls—Jno. L. Hayes Constr. Co., Yonkers, awarded contract for about 6½ miles impvt. on Whitehall-Dresden Center Rd., at $296,-915.

N. C., Raleigh—The Luck Co., Sylva, awarded contr. for impvt. of 15.22 mi. State Proj. 888, Yancey Co., at $166,565.

N. C., Raleigh—State Hwy. Comn. let following contracts aggregating in cost $4,750,000: Bertie Co. 7.12 mi. soil rd., to J. F. Mulligan Const. Co., No. Wilkesboro, at $31,191 for rds.; Boney-Hostetler at $20,852 for bridges; Martin Co. 12.36 mi. soil rd. to Jameson Bros., High Point, N. C., at $43,620, for ds.; J. A. Marrow, $34,160, for structs.; Martin Co. 12.36 mi. soil rd. to J. F. Mulligan Co., at $44,333; Batson Cook, West Point, Ga., at $37,845, for structs.; 8.80 mi. hard surf. rd., Durham Co., L. L. Tindell, Waterford, Wis., at $229,620; Dawkins Const. Co., Norfolk, Va., at $79,046, for bridges; Orange Co. 9.87 mi. bet. Almance & Hillsboro to R. M. Hudson Co., Salisbury, at $269,850; Davidson Co., 10.24 mi. hard surf. rd. from Lexington to Thomasville, Hagedorn Const. Co., Thomasville, at $322,832; J. A. Peterson, Montgomery, Ala., at $60,556, for structs.; Rockingham Co. 9.83 mi. rd. bet. Leaksville & Reidsville, Cheatwood-Driscoll, Richmond, Va., at $294,352, Atlantic Bridge Co., Roanoke, Va., at $95,292, for structs.; Rockingham Co. 2.10 mi. penetration macadam rd. from Madison to Mayodan, Geo. R. Martin, Salisbury, N. C., at $59,063; Ashe Co. 11.06 mi. gravel rd. to J. T. Plott, Greensboro, at $98,302, for structs., at $81,324; Surry Co. 2.22 mi. hard surf. rd. from Mt. Airy to Virginia line, Geo. R. Martin, $70,506; L. L. Tindall, at $199,428, for 7.03 mi. rd. bet. Chadburn and Whiteville, Columbus Co.; Southern Willette Paving Co., at $181,824, for 10.64 mi.; C. W. Lacey, Wilmington, N. C., at $147,466, for 8.98 mi. rd. bet. Castle Hayne and Long Creek, Pender Co.; Anson Co. 8.88 mi. hard surf. rd. from Wadesboro to Polkton, grading & conc. base to Lampton & Burks, Louisville, Ky., at $170,753; Topeka top to R. M. Hudson Co., Salisbury, N. C., at $76,171; Mecklenburg Co. 9.55 mi. reconstructed and widening base and asph. top bet. Charlotte and Cabarrus Co. line to Union Paving Co., Phila., Pa., at $222,833; Surry Co. 3.40 mi. hard surf. rd. from Yadkin River to Dodson Rd. to Campbell Constr. Co., Columbus, Ga., at $102,441; Wilkes Co. 4.97 mi. soil rd., J. F. Mulligan Const. Co., at $48,714; E. R. Robinson, Wilkesboro, N. C., at $29,492; Wilkes Co. 2.52 mi. hard surf. rd. to D. J. Brookshire Co., N. Wilkesboro, at $52,150; Cleveland Co. 1.58 mi. from Kings Mtn. to Gaston Co. line, Davis Wilcox Const. Co., at $52,150; Rutherford Co. 15.80 mi. soil rd. to C. R. Willard & Sons, Spartanburg, S. C., at $67,874; J. C. Zobriest, Monroe, N. C., at $13,044, for bridges; Buncombe Co. 7.57 mi. hard surf. rd. from Mine Hole Gap to Henderson Co. line, to Allport Const. Co., Asheville, at $293,577; R. C. Stevens, Asheville, for structs., at $16,693.

Pa., Oil City—D. A. Grant Co., Veach Bldg., awarded contr. for resurfacing 7 streets with asphalt, at $103,292.

Texas, Coleman—Womack Constr. Co., Sherman, Tex., awarded contr. to improve 17.72 miles State Hwy. No. 7; thru Coleman and Santa Ana to Brown Co. line, FAP. 194, at $190,000.

Tex., Sequin—Hayden & Austin, Hill & Marsh Sts., Houston, awarded contract by Guadalupe Co., to surf. 19 mi. State Hwy. No. 19 from Sequin to Bexar Co. line; 1½-in. inverted penetration bitum. topping, at $110,794.

Va., Richmond—Battlesell, Clay & Goode, Danville, awarded contract for extension of hwy. in Drapers Valley—10½ miles, at approx. $205,000.

Wash., Seattle—Olympia Const. Co. awarded contract for Olive Way et al., paving, at $133,065; D. H. Traphagen, contract for paving W. Lander St., at $8,451.

W. Va., Welsh—McDowell Co. Court let following contracts: 5½ mi. rd. from top of Indian Moun-

tain southerly to Albert Bros., Charlottesville, Va., at $203,400; 5¼ mile road toward War, to Walton Sudduth, Bluefield, W. Va., at $219,725—grade and rock surfacing.

SEWERAGE AND SEWAGE TREATMENT.

Ark., El Dorado—V. E. Schevenell Constr. Co., Memphis, Tenn., awarded contract for constr. of storm sewer and street paving at approx. $250,000.

Ont., Ottawa—Dominion Lock Joint Co., Hamilton, Ont., award. contract for constr. of sewer, at $80,000.

Fla., Lake Worth—Bunker & Lockman, Lake Worth, awarded contr. for San. Sewerage system and septic tank, Sec. 1 and Sec. 2, at $47,368 and $42,345, respectively.

Ky., Madison—Moreno-Burkham Constr. Co., St. Louis, Mo., contract for constr. of san. sewer system, at $65,400.

Mass., Boston—Following contracts for sewerage works let by city: Jos. Todesca, at $3,013, for wks. in Louder's Lane; DeChristoforo & Bros. Co., at $2,903, for works in Broadway; V. Barletta, at $11,979, for works in Allston St., Brighton; A. Cefalo, at $7,884, for works in Breck Av., Brighton, also works in Centre St., etc., West Roxbury, at $16,423; C. & R. Constr. Co., at $28,492, for works in Hereford St., city proper; Geo. J. Regan, at $12,920, for works in Savannah Av., et al., Dorchester; Bryan & Co., at $25,296, for Spring St. brook conduit in Centre St. and private land, W. Roxbury.

Mich., Detroit—J. Porath, 745 Griswold St., Ashland Ave. Sewer, Sec. 1, $331,951; A. Tobin, 449 W. Columbia Ave., Ashland Ave. Sewer, Sec. 2, $276,439; Jeynes & Affeld, 1208 Ford Bldg., Clark Ave. Sewer, Sec. 5, $238,362; Connelly Bros., 610 Lincoln Bldg., Euclid Ave., Arm Bates St. sewer, $56,556; Holbrook Ave., Arm Bates St. sewer, $47,182; W. Porath, 1410 W. Grand Blvd., Montcalm Ave., Arm Bates sewer, at $10,917.

N. J., Newark—O'Gara Constr. Co., 242 Market St., awarded contract by Passaic Valley Sewerage Commrs. for sewer connection, at $74,150.

Pensauken, N. J.—Jno. M. Kelly Contg. Co. awarded contract for sewer system here, at $179,468.

N. Y., Brooklyn—Following contracts let: D. Bonnacci, 672 Degraw St., relief sewers in Pitkin Ave., $20,047; N. Y. Ave.—E. N. Y. Ave. to Empire Blvd., $14,246; E. 39th St., $9,029; 18th Ave., $6,894; N. Y. Ave.—Midwood to Hawthorne Sts., $2,613; Ridge Blvd., $2,536; Nazzaro & Quierriero, 6712 11th Ave., E. 13th St., $5,863; to S. Ambrosio, 1016 60th St., 55th St., $4,566, sewer basins on southwest cor. Foster Ave. and E. 26th St., $401; n. e. cor. Ave. K. & E. 8th St., $326; Murphy Bros., 262 Bay 43rd St., relief sewer in Croamer St., $3,793.

N. D., Fessenden—Haggart Const. Co., Fargo, awarded contr. for sewer sys., at $40,000.

N. Y., New York—Patrick McGovern & Co., 50 E. 42nd St., awarded contracts for san. sewers and reconstr. of existing sewers in Carmine St., etc., at $235,000.

Ohio, Lima—J. W. Farley Const. Co. awarded contract for Main St. sewer and McHugh & Cole, contract for constr. of Bellefontaine Ave. sewer, at $599,121 and $141,478, respectively.

Okla., Tulsa—Standard Paving Co. awarded contract for constr. of outlet sewer (storm) for Kendall Dist. Way, at $115,333.

Utah, Ogden—Wheelwright Constr. Co., awarded contract to construct storm sewer along 40th St., at $54,499.

Wis., Milwaukee—Knowles-Fehr Co., Chicago, awarded contract for laying sewer thru Esterbrook Park at $149,301; 4,872 lin. ft. 42-in. conc. sewer, 206 vert. ft. of stand. manhole and an 18 in. cast iron syphon.

Wis., Milwaukee—Wenzel & Henach Co., 408 27th St., awarded contr. for intercepting sewer, at $269,183.

WATER SUPPLY AND PURIFICATION.

Cal., Sacramento—Mathews Const. Co., Sacramento, awarded contr. for filtration plant, at $770,951.

Cal., Santa Rosa—Butte Electrical Equipment Co., 530 Folsom St., San Francisco, awarded contract for constr. of artesian well, rein. conc. aerator flume, receiving reservoir with 350,000 gal. capy. pumping bldgs., compressors, motors, crane, pumps, meters, elec. machy., etc., at $45,000.

Ont., Timmins—Leo. Mascioli, Timmins, awarded general contr. for const. of sewers and water mains, at $40,000.

Ont., Woodbridge—Standard Const. Co., Mimico, Ont., awarded general contr. for water works system, at $30,000.

Fla., Orlando—Following contracts let: Renovating and enlarging water plant: Cranes to Arlington Eng. Co., Euclid, O., $2,500; condensers to D. H. Wheeler, N. Y. City, $11,560; wiring to Johnson Elec. Co., Orlando; boilers to Springfield Boiler Co., 1901 E. Cap. Ave., Springfield, Ill., at $27,114; superheaters to Power Specialty Co., 111 Bway., N. Y. City, $4,100; stack to Rust Eng. Co., Atlanta, Ga., $3,360; steel tank to Chicago Bridge & Iron Co., 105th & Throop Sts., Chicago, $3,360; cleaning water mains to National Co., New York City, $8,384; pumps to Morris Mach. Wks., 41 Cortlandt St., N. Y. City, $4,785; filtr. equipment to International Filter Co., 38 S. Dearborn St., Chicago, at $17,446; valves to Ludlow Valve Co., Ft. Adams St., Troy, N. Y., $5,553; fire hydrants to Columbia Iron Wks., 811 Boyce St., Chattanooga, Tenn., $2,784; water meters to Gamon Meter Co., 282 South St., Newark, N. J., $17,882; Venturi meter to Simplex Valve Co., 5722 Race St., Phila., Pa., $1,048; water pipe to U. S. Cast Iron Pipe Co., 71 Bway., N. Y. City, cost to be determined by amt. used.

Fla., Quincy—Burford, Hall & Smith, 3rd Natl. Bank Bldg., Atlanta, Ga., awarded contr. for improving water and light plant, at $40,000.

Ill., Martinsville—Foulkes Contg. Co., 705 Ohio St., Terre Haute, Ind., awarded contract for 8 miles 4, 6 and 8-in. cast iron mains, including valves, spcls. and fire hydrants, at $54,363.

Md., Baltimore—Frank Carozza, Continental Bldg., awarded contr. for constr. of high serv. reservoir on Reistertown Rd., 20,000,000 gal. capy., at $116,232.

Mich., Bay City—J. L. Sparling Co., awarded contract for constr. of substruct. for filtration plant for city's new water works, at $463,200; contract for superstruct. let to Bay City Stone Co., at $167,900.

Minn., Thief River Falls—C. M. Carlson, Thf. River Falls, awarded contract for 1,000,000 gal. capy. filt. plant, including plant bldg. and motor house, at $19,100; filter and pumpg. equipt. to J. G. Robertson, 2542 University Ave., St. Paul, at $15,170.

Mo., Eldon—Dwight Chaplin, Wichita, Kans., awarded contract for complete water system, at $64,494.

Mo., Versailles—Burd & Tripp, Hutchinson, Kans., awarded contr. for water works system, at $80,000.

N. H., Salmon Falls—Central Engrg. & Constr. Co., Central Falls, R. I., awarded contract by Salmon Falls Mfg. Co., for bldg. 1 sty. 30x60 ft., brk. and rein. conc. power house and hydro-electric plant, 1,800 h.p. capy., also redevelopment of Salmon Falls. Engr.'s est., $250,000.

N. Y., St. George—N. De Stefano, 257 Glenn Ave., Tompkinsville, awarded contract for water mains in various streets, at $66,669.

N. C., Charlotte—Tucker & Laxton Engrg. Contractors, awarded con for excav. and erection of filtr. plant, at $201,525; Grinnell Co., at $15,303 for gate valves; Southern Engrg. Co., at $26,680, for struct. steel; at $3,236 to Builders Iron Foundry, Providence, R. I., for 2 meters; at $11,372 to Roberts Filter Co., Darby, Pa., for operating tables, dry chem. feed machines and controllers, etc., at $45.50; to R. D. Cole Mfg. Co., Newnan, Ga., for tower and tank, surge tank and wash water tank. Contract for pumps will be let later.

N. C., Kernersville—Boyd, Higgins & Goforth, Charlotte, awarded contract for water works and sewerage systems, at $100,000; R. D. Cole, Newnan, Ga., contr. for standpipe.

N. C., Lincolnton—Boyd-Higgins & Goforth, Charlotte, awarded contract for 6 miles 6-10-in. sewer line, 2 mi. 6-in. water mains, 200,000 gal. conc. reservoir, pump and motor equipment, at $60,000.

Ohio, Cleveland—D. Pfahl & Co., Berea Rd., awarded contract for constructing Impvt. 8 of county water supply system; 25,400 ft. 6-21-in. cast iron pipe to D. Pfahl & Co., Berea Rd., at $88,532.

Ohio, Lyndhurst—Martin & McDace, 1452 W. 98th St., Cleveland, awarded contract for furnishing and laying 10,077 ft. 12-16 ft. cast iron mains, at $51,754.

Pa., Philadelphia—A. P. Smith Mfg. Co. awarded contr. for fire hydrants, at $20,000; Angelo T. Ellis, steel water pipe, for Waynut Lane, Germantown, etc., at $25,000; M. & J. B. McHugh, constr. rail fence and pipe line, etc., at 27th & Indiana Ave., at $25,000; J. Jos. McHugh, laying 33 and 48 in. cast iron pipe lines for Queen Lane filters, at $13,000; A. P. Smith Mfg. Co. contr. for stop valves, at $23,000; R. D. Wood Co., cast iron water pipes as required by Bureau of Water, at $70,000.

R. I., Scituate—Keystone State Constr. Co., 310 S. 13th St., Philadelphia, awarded contr. by Water Supply Bd., Providence, for bldg. tunnel portion of Scituate Aqueduct, at $1,318,340.

S. D., Mitchell—Porett & Tuttle, Mitchell, awarded contr. for 18,000 lin. ft. 6-10 in. cast iron water mains, hydrants, valves, etc., at $34,479.

Texas, Colorado—W. C. Weeks, Arlington, awarded contract for construction of sewers and water mains, at approx. $32,000.

Wis., Benton—Chicago Bridge & Iron Co., 37 W. Van Buren St., Chicago, awarded contract for 30,000 gal. steel water tank on stone tower, including pipe and valve connections; engr.'s est., $25,000.

Prospective Work

ROADS AND STREETS.

Ala., Anniston—State Hwy. Dept., Montgomery, will improve abt. 26 miles of road in Calhoun Co., beginning at Talladega line below Oxford, thru Oxford, Anniston, Piedmont & Jacksonville. Second Div. begins at Etowah line on Gadsden rd. and extends to Reed's Mill, connecting with highway that is being completed by Calhoun Co. from Reed's mill to Jacksonville. Expend about $500,000.

Ariz., Phoenix—About 22 miles on Granite Creek-Tusayan forest highway will be built.

Fla., Miami—Dade County Commrs. will improve roads. $1,000,000 bonds voted.

Fla., W. Palm Beach—Palm Beach Co. Commrs. plan constr. of following roads: Belle Glade to Lee Co. line, $234,000; Belle Glade to Pahokee, $156,000; Bacoms Point to Long Beach, $100,000; Okeelanta to South Bay, $40,000; Torty Isl. to mainland, $35,000; Gardenia to Miami Canal Lock, $4,500; Bacoms Point to Pelican Bay, $5,000; 21 miles bend to sugar mill, $10,000; Military Rd. or connection, $22,000; Lake Worth Rd. and bridge, $35,000; Chosen to Pahokee, $5,000; Okeclanta to Gardenia, $2,000. Considering issuing $650,000 road bonds.

Ga., Forsyth—Monroe Co. Commrs. plan bldg. 10 mi. hwy. from Forsyth to Juliette; also improve National Hwy. bet. Forsyth and Lamar Co. line. E. H. Davis, chf. Civil Engr., Griffin, Ga.

Ill., Peoria—Bd. Local Impvts. considering two street impvt. jobs: W. Virginia Ave.—Elizabeth St. to Garland Ave.—$20,000; W. Armstrong Ave.—Bestor to University—$20,000. Petition has been signed by a number of prop. owners requesting this last named impvt.

Iowa, Marion—Linn County has decided to pave 1 mile on Lincoln Hwy. thru Lisbon. Howard R. Green, Cedar Rapids Savgs. Bank Bldg., Cedar Rapids, will make plans. H. R. Churchill, Aud.

Ky., Whitley City—McCreary County will constr. county's part of Cincinnati-Lookout Mtn., Air Line rd. $200,000 bonds voted.

La., Abbeville—Good roads advocates backing proposed road into Chenier Au Tigre, 40-mile stretch of shell & sand beach front on gulf south of here.

La., Abbeville—$500,000 bonds voted for hard surf. roads in Vermillion parish.

La., Lake Charles—City Council plans 8 miles of paving here which will cost approx. $500,000.

Md., Baltimore—Paving Comn. has estimates on paving roads and streets in new annex.; $12,000,000. Paving in Mt. Wash. section will probably be Rectory Rd.—Wash. Ave. to end of rd; Fairmount Ave.—Rectory rd to end of avenue; Western run rd., from bridge over run to Fairmount Ave.; also repave Hillen St. to North Ave., $100,000; North Ave. to 25th St., $42,000; 25th St. to old city line, $141,000. R. Keith Compton, Chrmn., Paving Comn., City Hall.

Minn., St. Paul—State will expend more than $30,000,000 for good roads again this year. About one-third of amt. will be used on the 7,000-mile state system of trunk highways, and remainder by county and twp. authorities on secondary system. Among items on trunk hwy. budget are 684 mi. extensions of state's sys. of gravel surfaced rds. and 386 mi. grading. In addn. abt. $2,225,000 will be used for maint. an army of more than 1,000 patrolmen, one to mend and smooth each 5 mile sect. State hwy. aid aggregating $2,200,000 apportioned to counties and with nearly $18,000,000 local tax revenues will be used on secondary highways.

Miss., Pascagoula—Board of Supvrs. will ask for bids at October meeting with intention of letting contract sometime in November for bldg. link in Old Spanish Trail. No definite type of pavement decided on and bids for several kinds of hard surf. rds. will be invited. There is available abt. $170,000 for the impvt. General route of new hwy. as agreed upon is from eastern limit of paved rd. in East Moss Point past plant of Southern Paper Co., down to Ala state line.

Mont., Missoula—Stretch of 31 mi. rd. bet. Pablo and Rollings on Flathead Lake, eliminating big Polson hill, is to be constructed as soon after contr. is let this fall as possible. Geo. Labstrum, State Hwy. Commr.

N. J., Newark—Director Raymond, Dept. of Sts. & Pub Impvts., has instructed engineers to push work on paving program. Of a program of some 40 odd streets scheduled for impvt., only 12 are completed. Work Director Raymond desires most to have finished before winter is opening and widening of Bloomfield and Belleville Aves., opening and widening Clinton and Elizabeth Aves., widening of Park Pl., and repaving of Central, Elizabeth, and Clinton Aves.

N. C., Asheville—City Comrs. plan additional munic. impvts.; contemplate $375,000 bond issue as follows: $150,000 for street work; $100,000 for water works; $50,000 for incinerator; $50,000 sewer constr. and $25,000 for fire department.

N. C., Hendersonville—Henderson Co. Hwy. Comn. plans to build secondary and lateral roads on main highway from Buncombe Co. to 5c car line. $590,000.

N. C., Wilmington—City Commrs. plan paving following streets: Market, Castle, Orange, Princess, Chestnut, 17th, 3rd and Ann Sts.; 5th, Wolcott and Perry Aves.

Ohio, Cleveland—County Commrs. have authorized repaving of Detroit Ave., N. W.—West Blvd. to W. 117th St. Est. cost of impvt. $123,000. Co. Surv. Frank Lander. Street will be laid with Medina block.

Ohio, Lancaster—Fairfield County will receive $150,000 fed. aid for extension of impvt. of Cincinnati-Zanesville Rd. Co. Commrs. will put up $200,000.

Okla., Ardmore—It is planned that state legislature at next session be asked to appropriate $100,000 to pay for work which Murray Co. would be required to do in the constr. of new Davis Rd.—Ardmore to Davis.

Tenn., Greenville—$100,000 bonds sold. Will improve and extend streets, etc.

Tex., Alpine—$300,000 bonds voted by Brewster Co. for improving roads.

Texas, Corpus Christi—Nueces Co. will construct 50 miles hard surface road on State Hwy. No. 12; $1,500,000 available. C. E. Cocke, Co. Engr., Corpus Christi.

Texas, Nacogdoches—Nacogdoches Co. plans completing following roads: Hard surf. Mills hwy. extending 16 mi. thru Martinsville and connecting with hard surf. rd. in Shelby Co.; hard surf. Hobby Hwy. from Nacogdoches Co. line at Sacul to San Augustine Co.; hard surf. northern sect. Stone Fort Hwy. from Nacogdoches to Henderson; also plans bldg. following short line hard surf. roads: Tyler, Lower Douglas, Spanish Bluff, E. Appleby; Logansport; each 4 mi. from city limits; has tentative plans for $600,000 bond issue.

W. Va., Buckhannon—Buckhannon Chamber of

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Air Lift Pumps.
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Littleford Brothers.

Auto Fire Apparatus.
Diamond T Motor Car Co.
Duplex Truck Co.
Garford Co., The.
Kissel Motor Car Co.
International Motor Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling & Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L., The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
American Appraisal Co.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Gannett, Seelye & Fleming Co.
Hill, Nicholas S., Jr.,
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Morse, Wm. F.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Molds.
Austin-Western Co., Ltd., The

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Direct Oxidation Process.
Direct Oxidation Process Corp.

Disinfectants.
Integrity Chemical Co.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg Co., W. E.

Drawing Materials.
Kolesch & Co.

Dryers.
Cummer & Son., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

Com. interested in perm. impvts. to all state roads in Upshur Co. abt. 48 miles; approx. cost $1,500,000. Considering bond issue in connection with state and government aid.

Wis., La Crosse—City will call for bids in October for grading Winnebago St., Mississippi, 19th, 20th, 16th, Barlow, Ferry, West Ave., Horton, 23rd, 24th Sts. Actg. City Engr. Claire Congdon. M. Birnbaum, City Clk.

SEWERAGE AND SEWAGE TREATMENT.

Cal., El Segundo—$200,000 bonds voted for sewerage system here. A. W. Cary, City Engr.

Cal., Los Angeles—Citizens voted in favor of issuing $12,000,000 bonds for constr. of new sewer system here.

Cal., Oakland—Plans prepared for 17,960 lin. ft. 8-in. vit. pipe sewers, etc., in Melrose Acres. W. W. Harmon, City Engr.

Cal., Yuba City—$50,000 will be expended here for sewer system.

Colo., Denver—$32,000 ft. 8-in. and 1,200 ft. 10-in. vit. sewers may be constructed in Berkeley Special San. Dist. $49,000. A. K. Vickery, Engr. City Hall.

Ont., Ford—Plans being prepared for new sewers, $100,000. Prices wanted on materials. M. E. Brian, City Hall, Windsor, Engr.

D. C., Washington—Approx. $750,000 needed to complete the 3 big interceptor sewers which are to free the Potomac River, the Anacosta River and Rock Crk. from pollution. Time not far distant when work must be started on Oxon run interceptor, est. to cost abt. $1,000,000, needed to take care of large area east of Anacosta River which is developing rapidly into a home section.

Ill., Elgin—City will construct modern sewerage system to take care of sewage that now goes into the Fox River.

Ind., Ft. Wayne—Resolutions adopted by Bd. of Works for constr of 7 new sewers here.

La., Shreveport—City will build storm sewers, pavements, re-alarm sys., courthouse, jail, etc., etc. $4,000,000 bonds voted.

Mass., Athol—Appropriation of $60,000 made for general extension of sewerage system of the town; $1,000 for a drain in Kennekung St.; $1,500 for new drain bet. Miller's River and Exchange St.

Mass., Worcester—City Council's sewer committee recommended expansion of city's trunk system: sewer in Greenwood St. and extension of so-called Lincoln St. trunk sewer. Project will cost abt. $200,000. Constr. of sewer in Dorothy Ave., $3,000, and one in Cutting Ave., $3,060, also recommended.

Minn., Amboy—Plans being prepared by Cons. Engrs., Druar & Milinowski, 500 Globe Bldg., St. Paul. Will probably take bids in fall. Wm. Mead, City Clk.

Minn., Pelican Rapids—Prelim. surveys being made for san. sewerage system. Est. cost $40,000. Druar & Milinowski, 500 Globe Bldg., St. Paul, Engrs.

Mo., Parkville—Council has authorized formation of sewer dist. No. 2. Plans and specfs. agreed upon.

Mo., Springfield—G. W. Cullen, City Engr., has begun preparation of plans and specfs. for constr. of sewers in Dist. 41, Sec. No. 2—about 7,800 ft. of sewer.

Ohio, Sebring—Plans for sewage disposal plant here approved by council and will be sent to Columbus for approval by State Bd. of Health. It is hoped to begin work on the plant during the present year.

Okla, Bristow—$40,000 bonds voted here for purpose of improving san. sewer system and $70,000 to construct storm sewer system.

Okla., Sand Springs—Plans being prepared for storm and san. sewers. $90,000 bonds voted. Holway Engr. Co., 329 Kennedy Bldg., Tulsa, Engrs.

Pa., Erie—Revised plans for constr. of extension to east and west side intercepting sewers will be brought to city by J. T. Campbell of engrg. firm of J. N. Chester, Pittsburgh. It is possible public may be asked to vote on $300,000 worth of bonds at Nov. election.

Texas, Electra—City will rebuild sewage disp. plant. Est. cost $12.120.

Texas, Houston—City will expend $250,000 on new san. sewers within a year. Plans being drawn for laying of sewer mains to cost $80,000, and laterals to cost $170,000 will then be put in.

Texas, Lubbock—Plans being prepared for sewage disposal plant and extensions to sewers and water mains. $100,000. Hawley & Sands, Cotton Exch. Bldg., Ft. Wayne, Engrs.

Va., Richmond—City will construct permanent impvts. to sewer system of Shockoe Valley; will construct 2 outlets, one running along 15th St. bet. Hospital St. and the river. Cost bet. $2,000,000 and $3,000,000. Allen J. Saville, Director Pub. Wks.

Wash., Kelso—Plans being completed by Long-Bell Lumber Co., engineers for mammoth storm and san. sewer sys. for their community, which will be built southwest of West Kelso. 1st unit that will be installed will be gigantic storm sewer which will drain entire area of commercial and residential town.

Wash., Tacoma—Resolution passed for storm and san. sewers in entire So. Tacoma Dist. $950,000. J. C. Hanley, City Engr.

Wis., Beloit—City plans 41 miles san. sewers at cost of $450,000. Mead & Seastone, Journal Bldg. Madison, Engrs.

WATER SUPPLY AND PURIFICATION.

Ala., Birmingham—Ala. Power Co. has applied to Fed. Power Comn. for permit to constr. hydro-electric plant on Tallapoosa River in Ala., which will include 4 dams with total capy. of abt. 140,000 h.p.

Ala., Jasper—Jasper Water Co. will install sedimentation and filtering sys. at Lovely St. and 10th Ave. consisting of 2 pumps capable of 110 lbs. pressure, 2 centrif. pumps, one of 350-gal. per min., the other 250 gal. per min., filter, etc.

Ark., Ft. Smith—City Commr. has approved plans for impvts. and extension to water system. Est. cost $500,000.

Cal., Napa—$600,000 bonds voted here, $265,000 of which will be used to purchase sys. of Napa City Water Wks., balance for impvts., including single-arch conc. dam with gravity section, 108-ft. high, 600 ft. long at top, storing 630,000,000 gals. Cost, including control works and spillway, $220,000; pipe line from diversion dam in Milliken Canyon to proposed reservoir, 25,600 ft. 14-in. double dipped riveted steel slip joint pipe, 1,600 ft. 16-in. mach. banded, dipped riveted wood stave pipe, pressure break, valves, etc.

Cal., Napa—Plans being prepared by state for water works sys. for state hospital here. $175,000. State Dept. of Archt., Forum Bldg., Sacramento, Engrs.

Cal., Tracy—Will vote on issuance of $136,000 bonds for constructing septic tank, water main extensions, purchase of fire equipt., etc. W. D. Harrington, Engr., Tracy.

Cal., Williams—Election planned to vote on $50,000 bonds for constr. of water works system. C. E. Sloan, Santa Fe Bldg., San Francisco, Cons. Engrs.

Que., Montreal—Water Works Board plans 12,750 ft. 42-in. steel force main from St. Gabriel pumping station to Clarke Ave. H. A. Terreault, Direct. Pub. Wks.

B. C., Summerland—City contemplates constr. of reservoir of 400,000 gal. capy.; also installation of 6-in. main and hydrants in fire district.

Can., Toronto—City contemplates bldg. pumpg. sta., including intake, pumphouse, filterhouse, filters, pumps, etc., 40,000,000 to 60,000,000 gals. per day. $2,500,000. R. C. Harris, City Engr. and Comr. of Works.

Conn., Berlin—Plans being prepared for extension of water supply sys. Oldershaw & Crowley, 259 Main St., New Britain, Engr.

Fla., Jacksonville—City has accepted recommendation of Jos. E. Craig, Civil Engr., for impvts. to present hard and soft water supply; will construct dam to furnish hydro-elec. power to pump water from St. Mary's River to Jacksonville—25 miles.

Fla., Pensacola—City contemplates expending abt. $93,000 within next year on impvts. to water system. Frank D. Sanders, Commr.

Ill., Gridley—Town preparing to issue bonds in sum of $20,000 for purpose of installing system of water works.

Ill., Minonk—Prelim. steps being taken towards installation of water works system. It is pro-

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Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E. Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric .
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.

Hydrants.
The Flower Company.

Incinerators.
William F. Morse.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
Carey Co., Philip, The.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Loaders.
Brown Portable Conveying Machinery Co.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
The Barrett Co.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Co.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
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Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

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Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

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Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

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Smith Co., T. L., The
Warren Bros. Co.

Pipe Cutters.
W. W. Stickler & Bros.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

posed to issue bonds amounting to $20,000 to finance project.

Ia., Dubuque—Ready for bids soon for pumping sta. impvts. Est. cost $135,000. C. E. Mead & Seastone, Madison. O. E. Carr, City Mgr., City Hall.

Ia., Marshalltown—Plans accepted and will call for bids soon for low lift pumping sta. and pumps to be installed in water field. Engrs., Alvord & Burdick & Howson, Chicago. Anne McMahon, City Clk.

Ia., Wayland—Plans under way for water works; $25,000. W. E. Buell & Co., 205 Davidson Bldg., Sioux City, Engrs. Ray Roth, City Clk.

Ind., Mishawaka—City considering constructing new reservoir with capy. of 1,500,000 gals., installing 3 new high pressure pumps with ability to pump abt. 2,000 gals. water a minute; purchase of over 6 acres land and drilling of several new wells, together with purch. of lines and equipment. from Public Utilities Co. Est. cost of work $125,000. A. R. Klein, City Supt. Water & Elec. Depts. R. L. Baldwin, Hydr. & Constr. Engr., with Burns & McDonnell, Kans. City, Mo.

Kans., Satanta—Vote will be taken on issuance of $30,000 bonds for pumping and distributing systems. $40,000. Ruckel Engrg. Co., Interurban Bldg., Hutchinson, Cons. Engrs.

La., Alexandria—Plans being prepared and city will soon advertise for bids for mains and equipt. for water reservoir. Est. cost $95,000.

La., Bastrop—City will improve water works and electric plant. $45,000 bonds voted.

Mich., Loretto—Plans under way for constr. of power house and dam on Sturgeon River by Peninsular Power Co., Madison (owners). Engrs., Mead & Seastone, Madison. 55 ft. conc. arch dam, 250 ft. long; single vertical unit, 1,000 kw., 60 cycle, 3-phase, automatic sta., transmission line abt. 3 miles long. Will build by day work. $200,000.

Minn., Kenyon—Plans being prepared for conc. reservoir, 300,000 gals. capy., also high service pump, $15,000. O. B. Strand, Vil. Recorder. L. P. Wolff, 1000 Guardian Life Bldg., St. Paul, Engrs.

Minn., Owatonna—City considering constr. of tank, 31 ft. diam., 250,000-gal. capy.; also tower. $15,000. Toltz, King & Day, 410 Pioneer Bldg., St. Paul, Cons. Engrs.

Minn., Winona—Plans under way for pumping sta. Est. cost $260,000. Alvord, Burdick & Howson, Cons. Engrs., 8 S. Dearborn St., Chicago, Ill. Geo. W. Hoffman, City Clk.

Mo., Milan—City will extend water mains and construct filtration plant. $29,000 bonds voted.

Mo., Paris—City will install 2 oil engines, generator and complete equipment for water and light plant. Will probably vote on $55,000 bonds.

Mo., Pilot Grove—Plans being prepared for new water works system. E. T. Archer & Co., 609 New England Bldg., Kans. City, Mo., Engrs.

Neb., Omaha—Plans under way for water works impvts; 4 in. main from Florence pumpg. sta. to Walnut Hill reservoir, 7 miles. $500,000. Owner: Metropolitan Utilities Bd.—W. J. Coad, Chmn. Bd. of Directors.

N. Y., Batavia—City contemplates laying 6-in. mains in 400 ft. Bank St., 750 ft. State St., 500 ft. Hutchins St. 180 ft. Lewis Ave., 900 ft. Walnut St., 300 ft. Walnut Pl., 900 ft. Elmwood Ave., 375 ft. School St., 650 ft. Otis St., 650 ft. James St. 650 ft. Ross St., 1075 ft. Trumbull Pl., 325 ft. Seneca Ave., 500 ft. Eleanor Pl. and 375 ft. Hutchins Pl., $30,000.

N. Y., Canandaigua—City plans to construct mains, including 2½ miles 16-in. pipe from reservoir. $656,000.

N. Y., Dundee—Citizens of village propose to install water wks. system which will include erection of large storage reservoir.

N. Y., Lyons—It is planned to lay 2 miles of 6-in. cast iron water mains from Wayne Co. Home to village and connect with municipal water system.

N. C., Asheville—City considering constr. of impounding reservoir at Bee Tree, storage capy. of about 180,000,000 gals. Est. cost abt. $500,000. Chas. E. Waddell, Cons. Engr.

N. C., Charlote—City will invite bids within 3 weeks for constr. of filtr. plant of 10 million gals. $300,000 available. Wm. M. Piatt, Durham, N. C., Cons. Engr.

Ohio, Greeneville—Water Department contemplates bldg. purification and softening plant. G. D. Hankins, Service Director. Est. cost, $150,000.

Okla., Cushing—City contemplates extending water and sewer systems. $300,000.

Okla., Cyril—City considering extension of water system; will vote on $25,000 bonds.

Pa., Pittsburgh—W. Va. Power & Transmission Co., Pittsburgh, has applied to Fed. Water Power Comn. for permit to constr. 10 sep. developments on Cheat River in West Virginia and Pennsylvania; develop abt. 400,000 h.p.; lower dam and power house to be built near Monongalia-Preston County line.

S. C., Easley—City will extend water and light system; also pave walks. $50,000 paving bonds and $30,000 water & light bonds voted.

Texas, Alvarado—City will improve water works. $30,000 bonds voted for this purpose.

Texas, Austin—City will probably hold election to vote on $400,000 bond issue for impvts. to water sys. Walter L. Eyres, Water & Light Commr.

Texas, Amarillo—Water Board has recommended that surveys be made by Wynkott Kietsted, Cons. Engr., Kans. City, Mo., for water works; surveys to include water wells and damming Palo Duro Canyon and possibly Canadian River. Est. cost abt. $1,000,000.

Texas, Clifton—City considering improving water works. $30,000 available. P. E. Schow, Mayor.

Texas, Gunther—W. R. Huckaby, Van Alstyne, has purchased and will improve water works plant here.

Tenn., Johnson City—City will improve water works system; will vote on $65,000 bonds.

Texas, Shamrock—Atty. General's Dept., Austin, has approved bond issue in sum of $100,000 for water wks. impvts.

Texas, Teague—Plans being made for new water plant. $100,000. E. B. St. Clair, Teague, Engr.

Utah, Clearfield—City considering const. of new water works system. $50,000. Caldwell & Richardson, Templeton Bldg., Salt Lake City, Engrs.

Va., Richmond—Bd. of Pub. Utilities having plans prepared and will soon invite bids for constr. of booster pumpg. stations of 30,000,000 gals. daily capy.; install hydraulic turbines of 1,800-h.p., elec. generators and switchboards and pumps; will also improve water supply in S. Richmond, west of 25th St., including Woodland Heights and Forest Hill sections.

Wash., Camas—Plans being prepared for water works impvts., including 7 miles wood pipe. $40,000. Stevens & Koon, Spalding Bldg., Portland, Ore., Engrs.

Wash., Everett—City purchased 21-acre site for new 3-unit reservoir (one unit to be built at this time). Proposed storage dam will have capy. of 20,000,000 gallons. A. B. Gutter, 3410 Norton St., Engr.

Wash., Spokane—Proposed impvt. of No. Side water system to cost $200,000, including constr. of $80,400 reservoir near Minnehaha Pk., will meet with no opposition from City Council.

Wash., Spokane—Plans being prepared and bids will be taken early in 1923 for pumping outfit, one unit of 1,000 hp., 50,000-gal. per day, housing, 1 well 50 ft. diam., and 55 ft. deep, $65,000; new foundation for pump in old plant, 300 hp. eng., $15,000; 10,000 ft. 6-in. c. i. pipe to replace wooden pipe, $17,500; rein. conc. reservoir, 20,000,000-gal. capy., $14,000. A Lindsay, City Engr.

Wash., Tacoma—City considering laying 20 in. cast iron main from S. 35th St. to S. 54th St., on portions of J & K Sts.—9,456 ft. 20-in. and 1,392 ft. 6-in. cast iron pipe. $78,757. W. A. Kunigk, 402 City Hall, Engr.

Wash., Tacoma—Bd. of Pub. Wks. plans repairs to water system, including lining one end McMillin reservoir with gunite, lining 300 ft. 48-in. spillway pipe with steel and gunite reinforcing footings; also replacing pipe, involving 1,145 ft. 30-in. cast iron pipe; approx. cost, $51,500. I. S. Davisson, 923 S. 8th St., Engr.

Wis., Baraboo—Improvements to hydro-elec. power plant contemplated by Geo. MacArthur & water wheels, new generator and shrdlushrdlucf Sons, owners. Considering installation of new water wheels, new generator and impvts. to power sta. Mr. Ward, Engr., care Univ. of Wisc., Madison.

Wis., Dodgeville—Contemplates laying water mains and improving pumping sta. Engr. not selected. $25,000.

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Pumps.
De Laval Steam Turbine Co.
Harris Air Pump Company.
Keystone Driller Co.
Smith Co., T. L., The

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Kentucky Rock Asphalt Co.
The Texas Co.

Road Binder.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Keystone Driller Co.
Littleford Brothers.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co.
The Good Roads Machinery Co., Inc.

Roofing Material.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Saw Rigs.
C. H. & E. Mfg. Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling & Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Sewer Pipe Joint Compound
The Barrett Co.

Sewer Rods.
Stewart, W. H.

Slide Rules.
Kolesch & Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.
Phoenix Mfg. Co.

Soaps—Liquid.
Integrity Chemical Co.

Special Castings.
The Flower Company.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co., The

Stone Elevators.
Austin-Western Road Machinery Co., The

Stone Spreaders.
Austin-Western Road Machinery Co., The
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co., The
Littleford Bros.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Paving Material.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Road Machinery Co., The

Structural Steel.
Lewis-Hall Iron Works.

Subgrading Machines
Austin Machinery Corp.
The Hug Co.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Tamping Machines.
Pawling & Harnischfeger.

Tanks, Water Supply.
Littleford Brothers.

Tar and Pitch
The Barrett Co.

Tar Heaters.
Littleford Brothers.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Walter H. Flood.
Howard, J. W.
Kirschbraun, Lester.
Nutting Co., H. C.
Van Trump, Isaac.

Traction Engines.
Austin-Western Road Machinery Co., The

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Austin Machinery Corporation.
Holt Mfg. Co., Inc.

Traffic Signals.
Electrical & Specialty Supply Co.
Little Giant Co.

Trailers.
Lee Trailer and Body Co.

Trench Braces.
Kalamazoo Fdry. & Mach. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdry. & Machine Co.
Pawling & Harnischfeger.

Turbines, Steam.
De Laval Steam Turbine Co.

Turntables, Truck
The Hug Co.

Valves.
Coldwell-Wilcox Co.
The Flower Company.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Main Cleaning.
National Water Main Cleaning Co.

Water Pipe.
U. S. Cast Iron Pipe & Foundry Co.

Waterproofing.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
Coldwell-Wilcox Co.
The Flower Company.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Wire Rope.
American Steel & Wire Co.

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
Barrett Co., The
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Wood Preservatives.
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Through a Sieve Woven Finer Than Silk

Portland cement, to meet the exacting specifications of leading engineering socities and the United States Government, must be ground so fine that at least 78 per cent will pass a sieve having 200 wires per linear inch. A silk handkerchief has but 110 threads per inch—an excellent quality of silk dress goods 187 threads. The watch in your pocket hardly calls for a more complicated and carefully adjusted process of manufacture than the making of cement.

Grinding is only one of the many operations required to make it. Yet in grinding alone, see what is required:

The rocks from the quarry, often as big as a piano and heavier, go first into a gigantic "coffee mill." It bites at these huge chunks, chips them, and finally crushes them—to pieces six inches or so in diameter.

Two finer mills follow, one after the other, reducing the stones to the size of coarse sand. After this they must be ground in a great revolving cylinder half filled with steel balls, until every cubic foot of the rock has been reduced to 14 billion pieces —until 85 per cent of them will shake through a sieve that will actually hold water, a sieve with 40,000 holes to the square inch.

And all of this is less than half the necessary grinding. The coal must be ground. For the object of all this fine grinding of the raw materials is only that it may be fused into crystalline clinkers. And to fuse it requires pulverized coal—or its equivalent. Most plants use pulverized coal.

The coal must be ground as fine as the raw stone. Eighty-five per cent of it or thereabouts must go through the sieve that holds water. And that often means two grinding operations.

There is still the clinker to be ground. It is glass-hard to begin with. It must be ground first to the fineness of sand, and then ground and reground in another cylinder of steel balls—until at least 78 per cent of it will go through the sieve woven finer than silk.

Huge bowlders to an impalpable dust Common coal to an impalpable dust, and finally, after the burning, glass-hard clinker to an impalpable dust. That is the making of cement. And eight heavy grinding operations are required in the process.

Grinding is only one of the lesser heat and power consuming operations in cement manufacture.

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A National Organization
to Improve and Extend the Uses of Concrete

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